THE MONTHLY

Review

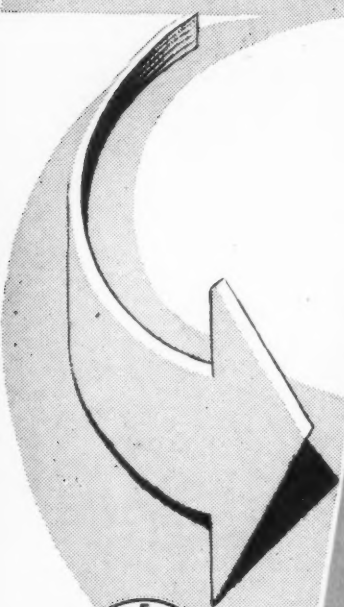
Official Organ of the American Electroplaters' Society
A Society for the Advancement of the Science of Electroplating

JUNE ✦ ✦ ✦ 1945

SPECIALIZED

CLEPO COMPOUNDS

To Speed Production and Reconversion Plans



ANODIC ELECTROCLEANERS
for Brass, Bronze, Copper, Steel and Zinc-Base Die Castings.

BURNISHING COMPOUNDS

CATHODIC ELECTROCLEANERS
for Aluminum, Brass, Bronze, Copper Magnesium and Steel.

CLEANERS for BONDERIZING and PARKERIZING.

CLEPOLON DEBURRING PROCESS
for all Metals.

COLD DEGREASING SUBSTITUTES

DESCALING COMPOUNDS
For Aluminum, Copper, and Brass.

HI-SPEED SOAKING CLEANERS
for all Metals.

STRIPPERS FOR ORGANIC and METAL COATINGS.

RUST PREVENTATIVES

TETRA-DIP PROCESS for Preparing Aluminum prior to Spot Welding.

WASH MACHINE COMPOUNDS

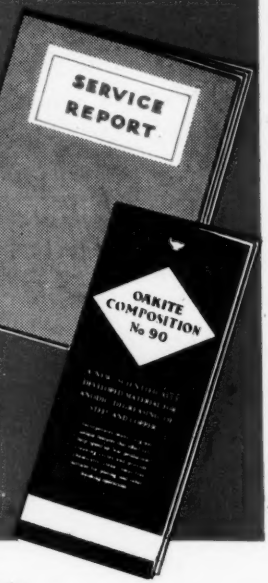
CLEPO — CLEANING COMPOUNDS

Contact Clepo Service Man For Demonstration

FREDERICK GUMM *Chemical Company Inc.*

538 FOREST STREET, KEARNY, N.J.

FREE! 2 OAKITE Aids to Help You Solve Your Reconversion Product Finishing Problems!



THESE two Oakite publications contain specialized data to help you solve diversified problems which the change to civilian production necessarily presents. Full of up-to-the-minute, practical information of techniques widely and successfully used!

Service Report Gives Details of Oakite CrysCoat Process

In ONE low-cost, time-saving operation, Oakite CrysCoat No. 86 removes light oils, grease and shop dirt . . . imparts a microscopic crystalline coating to steel or iron surfaces which prevents rusting and at the same time provides excellent and firm grippage for paint. ECONOMICAL . . . SPEEDS PRODUCTION . . . ELIMINATES paint adhesion failure due to incorrect surface preparation. Get the FREE Service Report giving essential details.

Precleaning of Steel and Copper Prior to Plating

If you are doing bright zinc, cadmium, hard chrome, nickel, copper plating or applying black oxide or similar finishes to steel or copper, you will find Oakite Composition No. 90 for ANODIC degreasing of surfaces gives FAST, THOROUGH smut removal . . . high conductivity . . . effective wetting-out and emulsifying action . . . long solution life. Get the FREE, 16-page concise Manual giving various applications, methods and directions for use.

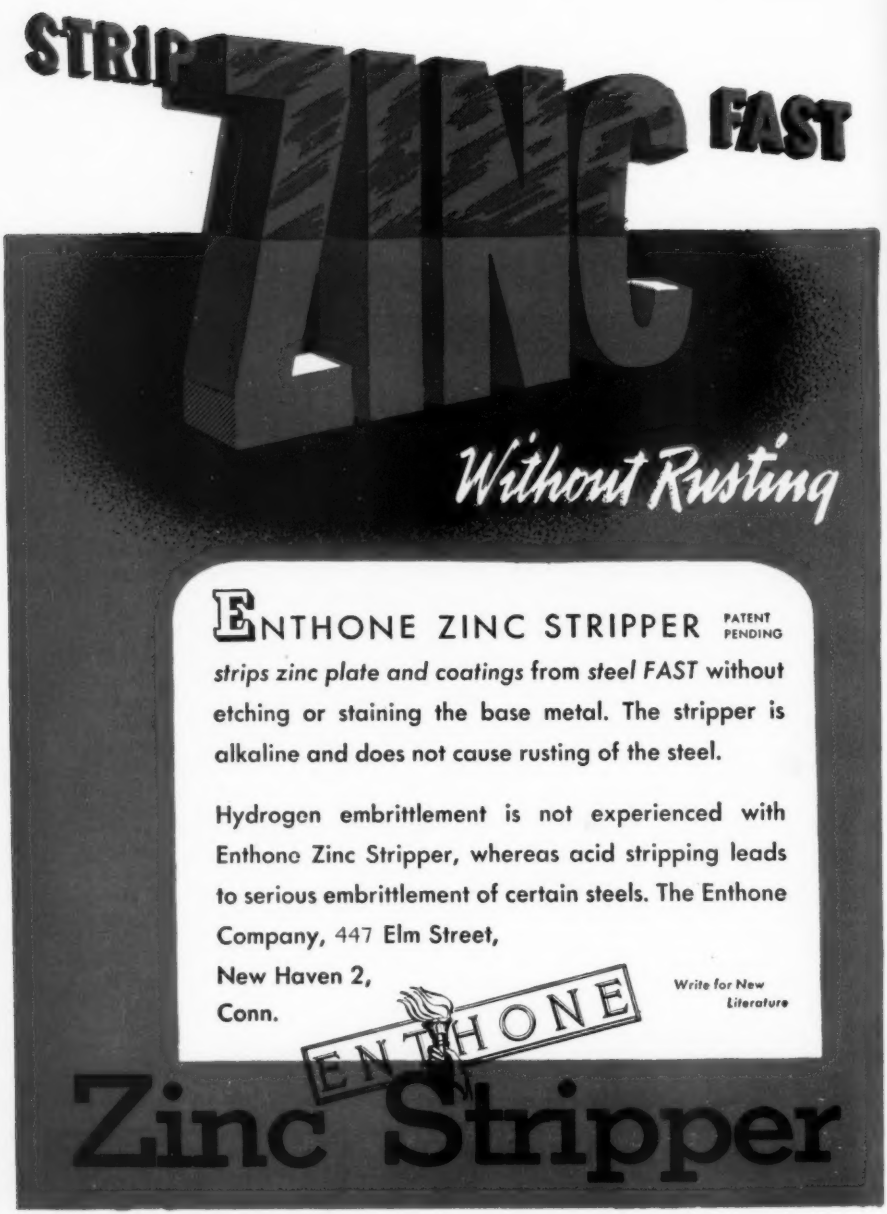
SEND FOR THIS HELPFUL DATA!

You are invited to send for the Special Service Report and the Manual. Both are FREE . . . there is no obligation!

OAKITE PRODUCTS, INC., 40 Thames St., NEW YORK 6, N. Y.

Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE Buy Bonds for Victory CLEANING


STRIP ZINC FAST
Without Rusting
ENTHONE ZINC STRIPPER PATENT PENDING
strips zinc plate and coatings from steel FAST without etching or staining the base metal. The stripper is alkaline and does not cause rusting of the steel.
Hydrogen embrittlement is not experienced with Enthone Zinc Stripper, whereas acid stripping leads to serious embrittlement of certain steels. The Enthone Company, 447 Elm Street, New Haven 2, Conn.
Write for New Literature
ENTHONE
Zinc Stripper

A BRIGHT ENDING TO YOUR TOOL FINISHING PROBLEM

Pick the wrench that your eye tells you is most attractive, and you'll pick the one that has been Luster-on* treated. This unretouched photograph presents unmistakable evidence of the appearance-value of Luster-on*, the chemical bright dip that makes dull zinc-plated surfaces look like glistening chromium.

Then consider that Luster-on* gives lasting protection from fingermarks, age stains and the unsightly blackening common to zinc articles. Luster-on* even makes zinc so passive that it can take salt spray without corrosion.

Luster-on* gives miraculous results, with an easy cold dip method that any plating shop can use. Yet Luster-on* is available today — for use by makers of tools and small metal parts — to bring sales appeal and surface protection to your products.

KEMO SAYS: Sorry we can't send samples of Luster-on*, but we will process and return pieces of work sent to us.

*Pat. applied for.

THE Chemical CORPORATION
93 Broad St., Springfield 5, Mass.

THE CHEMICAL CORPORATION
93 Broad St., Springfield 5, Mass.

Please send me full particulars about Luster-on bright dip for zinc surfaces. I am (am not) sending sample part for free dip. No obligation, of course.

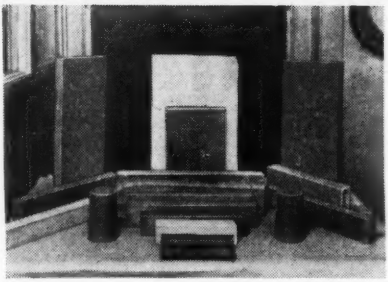
Name.....

Address.....

Monthly Review, June

Stevens

STEVENS SPECIAL SIZE CAKES



FOR AUTOMATIC COMPOUND FEEDERS

When cakes are clamped in mechanical holders there is a terrific strain on the compound when it hits the buff. This may cause breakage and injury to the operator or damage to the machine.

You can avoid this danger by using Stevens Special Size Cakes, which have a tough, strong texture—perfectly flat and parallel faces and uniform dimensions.

The large white cake at rear of picture is Stevens Stainless Steel. The cake is 12″ x 12″ x 18½″ and weighs over thirty pounds. The little "sliver" at front is Stevens Tripoli. This cake is ¾″ x 1½″ x 7½″ and weighs but eight ounces.

STEVENS COMPOSITIONS ARE "PRECISION" MATERIALS — EXACTLY UNIFORM IN FORMULA, TEXTURE, QUALITY, DIMENSIONS

There is a Stevens Composition especially developed for use on all types of mechanical or hand buffing operations.

For description of the complete Stevens Line, see our No. 27 Catalog. If you do not have a copy, we will mail one to you upon request.

"The Wise Buyer Buys — Stevens Supplies"

FREDERIC B. **STEVENS** INCORPORATED

DETROIT • 26 • MICHIGAN

- NEW ENGLAND — 165 182 Brewery St., New Haven, Conn.
- NEW YORK and PENNSYLVANIA — 93 State St., Buffalo, N. Y.
- INDIANA — Hoosier Supply Co., 16 S. Cruse St., Indianapolis, Ind.
- CANADA — 1262 McDougall St., Windsor, Ontario; 2165 Dundas St. West, Toronto, Ontario — FREDERIC B. STEVENS OF CANADA, LIMITED

BUFFING COMPOSITIONS • METAL POLISHERS AND ELECTROPLATERS SUPPLIES-EQUIPMENT

THE MONTHLY

Review

VOLUME 32 • JUNE • NUMBER 6

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JACK BAIN
Publisher
E. T. CANDEE
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Subscription: $3.00 a year

Entered as second class matter January 21, 1943, at the post office at New York, N. Y., under the Act of August 24, 1912.

28′ Pittsburgh Glass Tank handling 15% sulphuric acid at 185°F. for pickling steel bars.

GLASS TANKS BY "PITTSBURGH"

WHATEVER the job, the chances are there's a glass tank to fit your requirements. Pittsburgh Glass Tanks have been used successfully for such operations as metal finishing, compounding chemicals, storing liquids. And they've been used successfully, too, for many *unusual* purposes, such as cleaning of heavy engine parts; electrorefining of copper.

Glass tanks are impervious to acids, alkalis, nearly all liquids (even hot chromic acid). They are non-porous, non-absorptive. They don't contaminate their contents. Made of specially *tempered* glass with the strength and sturdiness for long service under hard usage. Able to withstand the shock of sharp temperature changes.

Available now in a wide variety of shapes, styles, and sizes: faced with glass, inside and out; with inner glass facing only: made of transparent glass; or of colored opaque Carrara Glass. Or your *present* tanks can be lined with glass. Send the coupon today for additional information.

"PITTSBURGH" stands for Quality Glass and Paint

Pittsburgh Plate Glass Company
2217-5 Grant Building, Pittsburgh 19, Pa.

Please send me, without obligation, your free folder giving full details about Glass Tanks by "Pittsburgh."

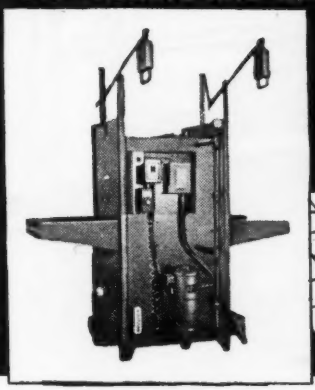
Name.....

Address.....

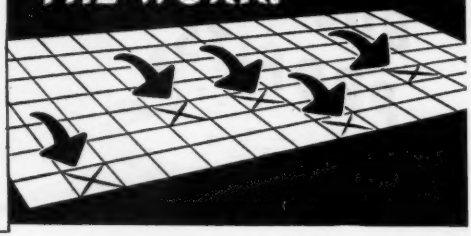
City..... State.....

PITTSBURGH PLATE GLASS COMPANY

FOR WASHING AND RINSING RIGHT ON THE SPOT...



TAKE THE MACHINE TO THE WORK!



Cut handling time and costs

In the individual cleaning and rinsing of metal parts, you can eliminate the needless extra handling that goes with carrying the work to and from distant metal washing equipment. The new OPTIMUS Single Stage Washer does away with that. With its use—you can easily *take the machine to the work!*

Rinse and wash in one unit

Not only is this new popular OPTIMUS unit readily portable, with it you can wash and rinse parts in the same unit. This obviates the need for a two-stage machine, saves space and cost. As easy as swishing parts around in a bucket—but lots safer.

Unit comes complete with moving jets and easy-operating vertical sliding doors that adequately control splash and spray. It can be equipped with any type heating device and thermostatic control.

An OPTIMUS Systematic Mechanized Plan for the handling of metal parts through metal washing, cleaning, pickling, drying and allied process operations, can assist you in establishing a *Plan* for your operations which will help save labor, reduce rejects and increase your production.

Write today for details as how OPTIMUS Systematic Mechanized Plan can be applied to your production activities.

Does a lot of cleaning in a small space

Small, compact, quick-working and handy, utilizing a floor area of only 12 sq. ft., this new OPTIMUS machine is fast meeting a wide and increasing demand for a low-cost space-saving unit that can be easily spotted right where the work is, *wherever* it is. Can be easily moved on to another spot as flow of work eases. Write today for new prospectus which describes this machine, its work and applications.

OPTIMUS EQUIPMENT COMPANY

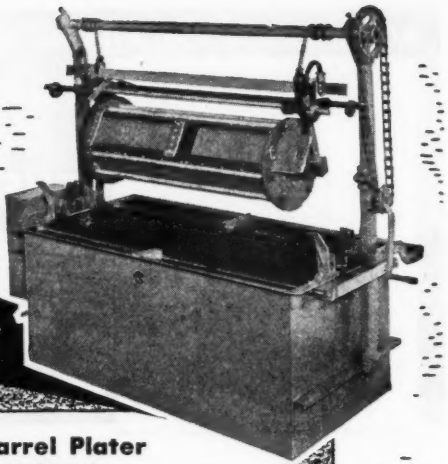
ENGINEERS AND MANUFACTURERS

CHURCH STREET, MATAWAN, N. J.

OPTIMUS EQUIPMENT

FOR WASHING • RINSING • PICKLING AND DRYING OF METAL PARTS

SPEED PLATING BOOSTS PROFITS!



Lasalco's Richards Barrel Plater Gives You These Advantages . . .

- Negative contact can be arranged to carry up to 800 amps.
- Heavy, flexible dangler imbedded in load gives perfect contact.
- Easily, quickly cleaned negative connection, separated from hanger arms, brought direct to work through hollow hub.
- Selective 3-speed drive.
- Anode rods, conductors, connections and switches are completely insulated from tank.
- Cylinder when lowered goes automatically into exact position thus engaging driving gears and electrical contacts without operator's attention.
- Cylinder construction of 5/16" laminated canvas Bakelite (as illustrated) or 3/8" hard bronze rubber. Special rod or woven types also available.
- Sizes, 12" (across flats) by 24", 30", 36" and 42" long for 24, 30, 36, or 42 qt. loads.
- Gear drive (as shown) or sheave drive if requested.
- Hand or tackle hoist. Ratchet device holds cylinder in any desired position.
- Effortless, speedy raising, loading, lowering or unloading.
- Nothing plates but the load.

Lasalco's Richards Barrel Plater is a "must" where speed and economy are vital to profits. Write today for complete information!

MEMO
Call a Lasalco Engineer

LASALCO, INC.

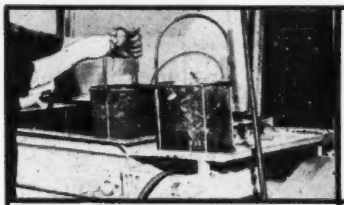
2818-30 LA SALLE STREET ST. LOUIS 4, MISSOURI

Fit the Cleaner—and the Machine to Your Finishing Requirements!

When you use the right Magnus Cleaner suited to the metal or metals being cleaned, the nature and extent of dirt and the finishing operation involved, you can improve results still further by using the type of Magnus Cleaning Machine best adapted to your production set-up.

The Magnus Aja-Dip Cleaning Machine deserves investigation, because of its versatility and wide range of application, even where batch operations may not appear desirable at first thought, and its extra speedy cleaning results.

Let us show you how this machine speeds and improves cleaning by moving the work up and down many times a minute *in* the cleaning solution.

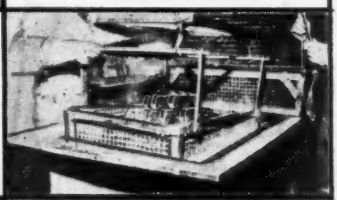


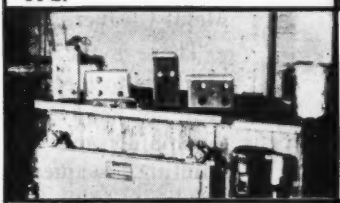
◀ BEFORE PLATING

For steel, Magnus 94XX. For brass, zinc, die cast and soft metals, the Magnus Electrex Cleaner suited to the metal or metals and the dirt involved.

AFTER STAMPING ▶

For most lubricants on all metals but aluminum and zinc, Magnus 94XX. For the latter, Magnus 92-S. For polished and machined aluminum, Magnus 91-S.



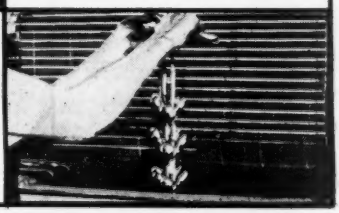


◀ AFTER OIL QUENCHING

For the removal of carbonized deposits, Magnus 24-S, which combines adequate alkalinity with the cleansing and rinsing properties of soap.

AFTER BUFFING ▶

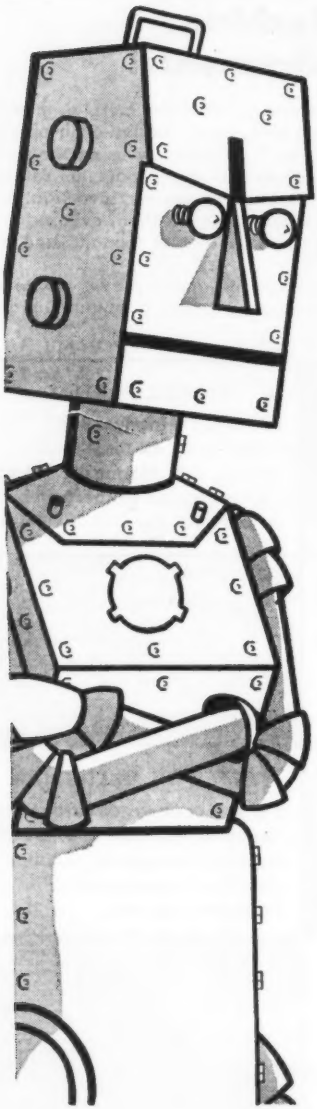
For precleaning before electroplating and for final cleaning where a physically clean surface is adequate, Magnusol in the Emulso-Dip or Emulso-Spray Process.



Magnus

MAGNUS CHEMICAL CO. 41 SOUTH AVENUE, GARWOOD, N. J.

Cleaners • Methods • Machines



A TOUGH BABY TO KEEP CLEAN

In stories and movies, scientists are always making robots that come alive and threaten to get the best of them.

Something like this has happened in real life. Because metal plays an increasingly essential part in our civilization, there is a corresponding increase in metal cleaning problems. That's why so many up-to-date plants depend on Wyandotte Metal Cleaners.

There is one of these specialized products to meet almost any metal cleaning need — for cleaning after machining and prior to plating, painting, lacquering, blackening, anodizing or spot welding.

The Wyandotte Representative will gladly help you with any metal cleaning problems. Call him today.

Wyandotte
REG. U. S. PAT. OFF.

WYANDOTTE CHEMICALS CORPORATION • J. B. FORD DIVISION
WYANDOTTE, MICHIGAN • SERVICE REPRESENTATIVES IN 88 CITIES

Joe the Job Plater Says:

HARSHAW PURE ZINC ANODES

made from electrolytically refined virgin metal are the best we ever used

Joe has several tangible reasons for his strong declaration in favor of Harshaw Pure Zinc Anodes. Purity alone has paid Joe important dividends through such extra plating improvements as:

1. Uniformity of color
2. Ease of handling
3. Reduced contribution to solution impurities

Practical plating experience gained in the field combines with laboratory research to make Harshaw Anodes and Chemicals satisfy the most exacting plater . . . and maintains Harshaw's top recognition in the plating industry.

Reduce your scrap pile . . . keep production rolling along . . . order Harshaw materials for silver, cadmium, zinc, chromium, lead, copper, nickel, and tin plating.

SEND FOR

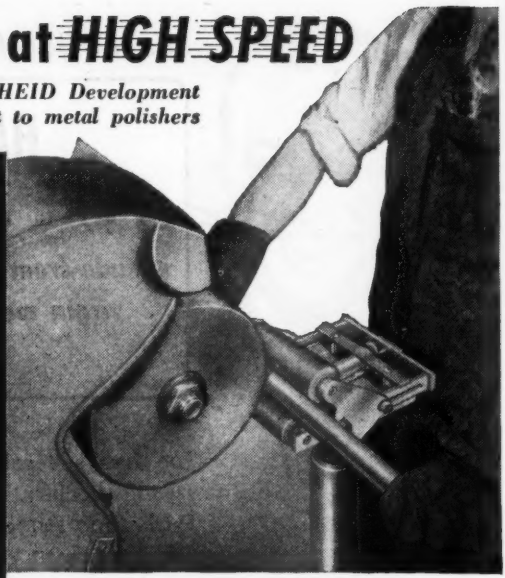
- **Lead Plating Booklet of Practical Information**
- **32-page book listing Industrial Chemicals**
- **72-page price list of Laboratory Chemicals**

HARSHAW

THE **HARSHAW CHEMICAL** CO.
1945 East 97th Street, Cleveland 6, Ohio
BRANCHES IN PRINCIPAL CITIES

Polishing Tubes at HIGH SPEED

Another MANDERSCHEID Development of incalculable benefit to metal polishers



The rubber rollers hold the tube against the polishing wheel with *uniform* pressure. As the tube rotates, it *automatically* feeds slowly across the polishing wheel. The *rate of feed* is *easily and accurately adjustable to suit the job.*

Five times greater production *without the usual spiral effect which is so prevalent when tubing is polished by hand.* These are the results users are getting with Presto Semi-Automatic Tube Polishing Machines.

Presto Polishing Machines are *completely* portable and *adjustable* for use with any polishing lathe. You merely push the machine up to the wheel—adjust for height and to fit the tube—insert the tube—and you are ready to do a marvelously *uniform* polishing job *at high speed.* Total set-up time is *less than five minutes.*

What's more, when the tube polishing job is finished, the polishing lathe *is not tied up.* You merely set the Presto Polishing Machine aside, ready for use with any lathe in your plant when you need it.

Durably built and priced so reasonably you can't afford to be without it.

Ask your jobber or write for particulars.

Other Accessories
by MANDERSCHEID
that effect big savings for
METAL POLISHERS

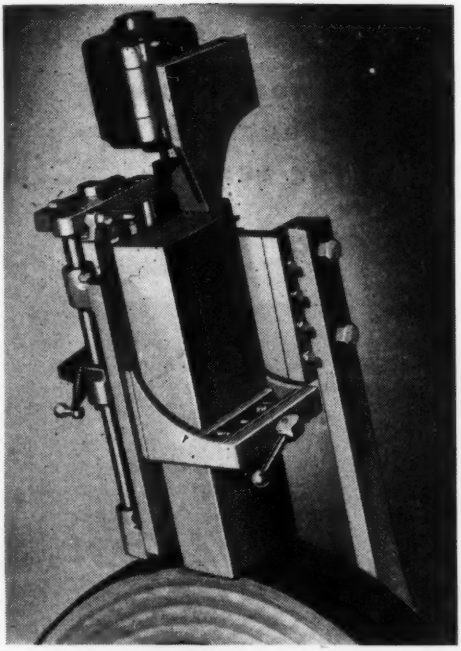
Presto Polishing Wheel Bushings
Modern Wheel Rakes
Jiffy Balancing Weights
Presto Balancing Ways for Polishing Wheels

Send for MANDERSCHEID Bul. 102 on Polishing Room Accessories

The MANDERSCHEID *Co.*

605 West Washington St., Chicago 6, Illinois

Serving the Metal Finishing Trade over 35 Years.



★ ELIMINATES HAND OPERATIONS

★ REDUCES BUFFING REJECTS

★ AVOIDS WASTING COMPOUND

Save ON BUFFING Costs

Tests show that the Nankervis Automatic Compound Applicator cuts buffing costs as much as 40% and improves speed and uniformity of production as well.

The NANKERVIS Applicator is light, sturdy and trouble-free. It is adaptable to all types of automatic polishing machines and adjusts easily to any angle.

It may be used for simple or complex jobs, singly or in multiples for staging. Its thrifty, automatic operation will more than repay its cost in a short time.

Write for complete specifications and details.

GEORGE L. Nankervis COMPANY

5408 COMMONWEALTH AVE. • DETROIT 8, MICHIGAN

COMPLETE METAL FINISHING EQUIPMENT

AND TOMORROW'S
PRODUCTS
FOR PEACE...

EGYPTIAN *Finishes*

Today most of Egyptian's wide range of finishes is devoted to the war . . . high quality finishes for war material used in the war or related to it.

Through the war years Egyptian has steadily maintained the reputation for quality which has marked Egyptian products for over half a century. You can depend upon Egyptian for the finest finishes obtainable . . . for the war materials you are making today; for the post-war products you will make tomorrow.

Inquiries concerning your present and future finish needs are invited.

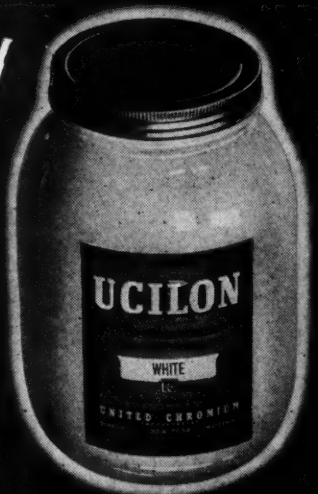
THE EGYPTIAN LACQUER MANUFACTURING COMPANY
ROCKEFELLER CENTER, NEW YORK 20, N. Y.

EGYPTIAN
SPECIALIZED PRODUCTION FINISHES

PRODUCT IN THE NEWS

STOP CORROSION

WITH THIS PLASTIC BASE MATERIAL APPLIED LIKE PAINT!



UCILON* is more resistant to *more* corrosive elements than any coating you ever tried.

Available in white, clear, black or colors.

Because of the special resins and solvents used, UCILON* is restricted today to specific end uses.

WHAT **UCILON*** is a new surface coating material which resists *all* acids in commonly used concentrations – *all* alkalies and salts at ordinary temperatures—plus alcohols, petroleum derivatives and natural oils. It is non-toxic, non-conductive, inhibitive to fungus.

WHERE **UCILON*** protects the surfaces of process equipment, piping, walls, beams, ductwork, tanks, etc., *where other coatings fail.* It produces an attractive, glossy finish on metals, wood, or concrete,—gives products subject to corrosion extra service, extra sales appeal.

UNITED CHROMIUM
INCORPORATED
51 East 42nd Street, New York 17, New York

HOW **UCILON***, compounded from special synthetic resins, can be brushed, dipped or sprayed like ordinary paint. Formulations for special needs such as quick drying, elasticity, matte surface, etc.

*Trade Mark Reg. U.S.Pat. Office and Foreign Countries.

FREE BULLETIN tells how you can save time, labor and materials in protecting surfaces against even the most destructive elements.

USE THIS COUPON

UNITED CHROMIUM, INC.
51 East 42nd Street, New York 17, N. Y.

Send illustrated UCILON* Bulletin without obligation.

*Name*_____

*Company*_____

*Address*_____

REMOVE PAINT

CLEAN METAL with FIDELITY

Stripping and Cleaning Compounds

No matter what the surface looks like, the right Fidelity product will restore it to clean metal in record time!

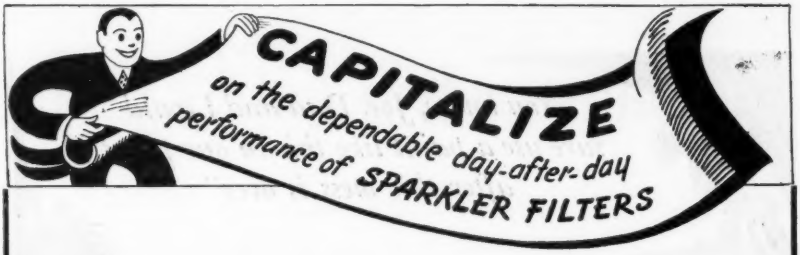
Coats of paint and enamel break loose easily with the proper stripper. Grease and grime quickly dissolve with the correct cleaner. The result is a perfectly clean surface, ready for any type of finishing.

Call in a Fidelity service engineer today for a free survey of your cleaning requirements. His recommendations will help to step up efficiency in your plant.

FIDELITY CHEMICAL PRODUCTS CORP.

"Serving industry with cleaning and stripping compounds"

430 RIVERSIDE AVE.
NEWARK 4, N. J.
HUmbolt 3-3640



The design of the Sparkler horizontal plate insures consistently uniform, highest quality filtration of plating solutions at great economy in time, operation and filter aid.

The thoroughness with which Sparkler Filters clean up and polish solutions of all kinds makes for smoother application and enhances the brilliancy of the finishes. Filter plates are interchangeable and easy to clean.

Choice of all-steel, hard rubber, stainless steel or lead-line construction.

Sparkler offers free filtration survey service through its conveniently located field engineers. Write for this service, or any special data.

MANY MODELS
50 TO 10,000 G.P.H.

SPARKLER MFG. COMPANY

274 LAKE STREET
MUNDELEIN, ILLINOIS

A hand grenade with a beautiful finish? Yes, American made hand grenades ARE beautifully finished with lacquer enamels to resist wear and corrosion.

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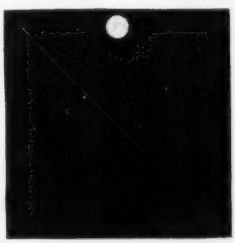

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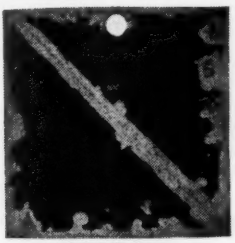

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SPECIFICATION ZINC PLATING ON STEEL SHEETS

BY W. H. SAFRANEK*

IN 1942, when the War Production Board established rigid controls on the use of nickel and other alloy materials for steel, and encouraged manufacturers to substitute less critical metals where possible, the aircraft industry began to use zinc plated steel sheet for assemblies requiring medium high tensile strength without sacrifice to ductility, and corrosion resistance. Some of the parts fabricated from this sheet were firewalls, engine accessory installations, fuselage cover assemblies, fixed gun installations, engine cowling installations, heating and ventilating systems, pyrotechnics installations, engine nacelle flame assemblies, wing installations, cooling installations, shell extraction chutes, ammunition boxes, hose clamps, and flexible conduits.

The Army-Navy aeronautical specification AN-P-32, requiring a minimum thickness of .0005" zinc, was used as a base for zinc coated sheets. In addition, the aircraft plants were able to simplify their spot welding techniques when the maximum variation in thickness of coating was limited to .00020". Accordingly they specified a minimum thickness of .00050" and a maximum thickness of .00070" on both sides of all sheets.

This rigid specification required a thorough study of the problem of plating uniformity. Experiments were made with special materials for use in equipment designed for supporting sheets and conducting the large quantities of current required. New designs in equipment were studied in an effort to insure uniform distance between the work and the anode area. Special anodes were constructed to reduce current densities near the edges of the sheets. Considerable auxiliary equipment was investigated as a means for promoting constant thickness of coating. Some of this equipment was successfully adapted to the new process and was used on two to three shifts for more than two years.

Thickness of coating is a function of current density, time, and cathode efficiency. Current density is easily controlled by means of adjusting the field rheostat on each generator. Operators load a new sheet each time an alarm rings which is controlled by an automatic resetting clock. Although cathode efficiency is more constant for acid zinc solutions, a greater throwing power exists for alkaline solutions. In order to take advantage of the higher throwing power value of the cyanide solution and because acid solutions require critical rubber lined tanks and equipment, a "semi-bright" cyanide solution was chosen for the electrolyte. All organic brighteners were avoided to insure maximum ductility of the deposit. Maximum reflectivity was maintained solely by the

*Formerly of Apollo Metal Works, Chicago, Illinois. Present address: Research Engineer, Battelle Memorial Institute, Columbus, Ohio.

use of a purifying agent together with control of optimum operating conditions.

To maintain uniformity of plating from load to load and hour after hour, many factors influencing cathode efficiency were automatically controlled. Solution circulation was used as a means for maintaining uniform and constant concentration of solution. Automatic temperature control was used to operate motor valves regulating flow of water through cooling coils. With this equipment, temperature of electrolyte, the most important single factor determining cathode efficiency, was controlled within 2° F. The cooling problem was a considerable one because sufficient 65° F. - 68° F. water had to be circulated uniformly through the tanks to compensate for the heating effect of 5 amps. per gallon of solution.

Chemical additions were made on a continuous basis by pumping solution from the plating tanks to a mixing tank where hourly additions were made. From the mixing tank, overflow solution passed into a lower level overflow tank from which solution was metered out by metering pumps to each individual plating tank as shown diagrammatically in Figure 1. Source of metal was zinc oxide used with insoluble high carbon steel anodes. There are several reasons for using the oxide in place of soluble zinc anodes. The cost of zinc in the oxide manufactured directly from the ore is considerably less than Prime Western Zinc. No shut-downs are necessary to replace corroded zinc anodes. Rough deposits with zinc oxide are virtually unknown compared to operation with zinc anodes which frequently produce unsatisfactory deposits if the zinc steel anode ratio or the cyanide and zinc ratio are permitted to become unbalanced. There is no difference between the purity, crystal structure, of physical properties of the plate from an electrolyte replenished with zinc oxide and the properties of deposits from solutions dependent upon electrolytic corrosion of zinc. Certain metallic and organic impurities in solution, however, do affect these properties unless precipitated from solution. The effect of these impurities is no less sensitive with solutions electrolyzed with zinc anodes, nor is the purity of the original oxide less than that of Prime Western Zinc.

Supervisors were trained to make ampere adjustments to compensate for changes in the area of the load and for other variables affecting cathode efficiency not compensated for by automatic equipment. Inspectors were trained to measure the thickness of coating on both sides of every sheet at several locations with Aminco-Brenner Magne-gages. Rejects were sent back to the plating department for stripping and replating.

Along with the mechanical and administrative program, a study of the factors affecting the cathode efficiency and throwing power of the electrolyte was made in the laboratory. Preliminary work indicated that an increase in throwing power usually resulted in a decrease in cathode efficiency. The apparatus used for the experiments, sketched diagrammatically in Figure 2, is described as follows: Two standard Haring cells,[1] with inside dimensions of 15 cm. x 5 cm. and filled to a depth of 5 cm. were hooked up in series with a variable resistance slide wire, an ammeter, and an acid copper coulometer containing 200 grams per liter of copper sulfate and 100 ml. per liter of sulfuric acid. The cells were immersed in individual trays where circulating hot or cold water maintained the desired temperature of the electrolyte within two degrees, plus or minus. In accordance with the Haring cell practice, the perforated sheet zinc anode for each cell was secured at a distance of 2.5 cm. from the near cathode at one end and 10 cm. from the far cathode at the other end of the cell. Thus the primary current distribution ratio was 5:1. In each case, throwing power and cathode efficiency was calculated as follows:

$$\text{Per cent Throwing Power} = 5.0 = \frac{\text{deposit weight on near cathode}}{\text{deposit weight on far cathode}} \times \frac{100}{5.0}$$

$$\text{Per cent Cathode Efficiency:} \quad 100 = \frac{\text{weight of deposit on both cathodes}}{1.03 \times \text{copper lost from coulometer anode}}$$

1. "Throwing Power, Cathode Potentials, and Efficiencies in Nickel Deposition," Trans. Am. Electrochemical Society 46, 107 (1924).

TABLE I

TABLE I

REPRESENTATIVE VALUES FOR HARING CELL EXPERIMENTS

Solution Used: H-4 described in Table IV.
Temperature: 92° + 1° F.
Current through circuit: 2.8 amperes (.056 amps. per sq. cm. — .362 amps. per sq. in. — 52.0 amps. per sq. ft.)

Run No.	*Cell No.*	*Loss in weight copper anode Grams*	*Deposit on near cathode Grams*	*Deposit on far cathode Grams*	*Ratio of Deposits near cathode to far cathode*	*Weight of Total Deposit near cathode plus far cathode*	*Per Cent cathode efficiency*	*Per Cent throwing power*
1	1	.846	.491	.181	2.71	.672	77.3	45.7
2	2	.927	.550	.193	2.85	.743	78.1	42.9
3	1	.903	.522	.186	2.81	.708	76.3	43.7
4	2	.903	.518	.191	2.72	.709	76.4	45.6
Average		—	—	—	—	—	77.0	44.5

TABLE II

EFFECT OF SODIUM SULFIDE ON EFFICIENCY AND THROWING POWER

Solution	*NaCN oz. per gallon*	*ZnO oz. per gallon*	*Ratio* $\frac{NaCN}{ZnO}$	*NaOH oz. per gallon*	*Na_2S grams per liter*	*Per Cent Cathode Efficiency*	*Per Cent Throwing Power*	*Cathode Efficiency Plus Throwing Power*
E-1	17.2	8.9	1.93	10.9	None	89.1	33.7	122.8
E-1	17.2	8.9	1.93	10.9	.20	83.0	44.8	127.8
E-1	17.2	8.9	1.93	10.9	2.0	78.2	47.4	125.6
I-1	25.1	8.9	2.83	10.8	None	57.8	51.1	108.9
I-1	25.1	8.9	2.83	10.8	.20	42.6	64.7	107.3
Table VII	17.2	8.9	1.93	10.9	None	84.5	30.7	115.2
Table VII	17.2	8.9	1.93	10.9	.20	71.7	50.1	121.8

Operating Conditions: All solutions: 92° F. plus or minus 1° F. : 2.8 amps. or 52 amps. per sq. ft. The last two solutions, labeled "Table VII" contained 4.0 oz. per gallon of $NaHSO_3$.

TABLE III

EFFECT OF INCREASING THE RATIO OF SODIUM CYANIDE TO ZINC OXIDE

Solution	*NaCN* oz. per gallon	*ZnO* oz. per gallon	*Ratio* $\frac{NaCN}{ZnO}$	$Zn(CN)_2$ oz. per gallon	*Free NaCN* oz. per gallon	*NaOH*	*Per Cent Cathode Efficiency*	*Per Cent Throwing Power*	*Throwing Power Plus Efficiency*
A-1	14.2	10.1	1.41	14.6	2.0	12.1	94.6	33.0	127.6
B-1	16.1	10.0	1.61	14.6	3.8	12.3	93.8	35.0	128.8
C-1	16.0	9.4	1.70	13.6	4.65	11.6	92.1	39.2	131.3
D-2	17.2	9.4	1.83	13.6	5.85	10.9	89.4	40.4	129.8
E-1	17.2	8.9	1.93	12.9	6.3	10.9	83.0	44.8	127.8
F-1	20.0	9.7	2.06	14.0	8.3	11.5	79.3	47.2	126.5
G-1	21.3	9.5	2.24	13.7	9.9	11.0	69.3	50.3	119.6
H-1	21.1	8.8	2.40	12.7	10.5	9.5	64.1	54.9	119.0
I-1	25.1	8.9	2.83	12.9	14.3	10.8	42.6	64.7	107.3

Operating conditions: All solutions: 92° F. plus or minus 1° F. : 2.8 amps. or 52 amps. per sq. ft. All solutions contained 0.20 grams per liter of Na_2S.

TABLE IV

EFFECT OF DILUTION

Solution	*NaCN* oz. per gallon	*ZnO* oz. per gallon	*Ratio* $\frac{NaCN}{ZnO}$	*NaOH* oz. per gallon	*Temp.*	*Amps. per sq. ft.*	*Per Cent Cathode Efficiency*	*Per Cent Throwing Power*	*Efficiency Plus Throwing Power*
D-1	34.0	18.6	1.83	13.0	92	52	92.1	31.9	124.0
D-2	17.2	9.4	1.83	10.9	92	52	89.1	40.4	129.5
D-3	13.3	7.3	1.83	10.7	92	52	88.4	42.2	130.6
D-4	8.85	4.9	1.83	11.1	92	52	88.7	42.1	130.8
H-1	33.3	13.9	2.40	9.4	92	52	60.4	58.4	118.8
H-2	21.1	8.8	2.40	9.5	92	52	64.1	54.9	119.0
H-3	12.6	5.1	2.45	9.5	92	52	74.1	45.2	119.3
H-4	9.2	3.9	2.36	10.1	92	52	77.0	44.5	121.5

TABLE V

EFFECT OF TEMPERATURE ON EFFICIENCY AND THROWING POWER

Temperature	*Per Cent Cathode Efficiency*	*Per Cent Throwing Power*	*Cathode Efficiency Plus Throwing Power*
78°	80.1	45.9	126.0
92°	89.4	40.4	129.8
110°	93.7	35.6	129.3
125°	96.1	30.2	126.3
144°	97.1	24.2	121.3

Solution Tested: Solution D-2 (Table III) containing 17.2 oz. per gallon NaCN; 9.4 oz. per gallon ZnO; 10.9 oz. per gallon NaOH, and 0.20 grams per liter Na_2S.

Operating Conditions: All tests—2.8 amps. or 52 amps. per sq. ft.

TABLE VI

EFFECT OF CURRENT DENSITY ON EFFICIENCY AND THROWING POWER

C.D. Amps per Sq. Ft.	*Temperature*	*Per Cent Cathode Efficiency*	*Per Cent Throwing Power*	*Cathode Efficiency Plus Throwing Power*
21	92° F.	97.4	25.1	122.5
35	92° F.	94.2	32.8	127.0
52	92° F.	89.4	40.4	129.8
72	92° F.	77.0	44.0	121.0
96	92° F.	66.0	49.8	115.8
35	125° F.	97.0	23.5	120.5
52	125° F.	96.1	30.2	126.3
96	125° F.	89.9	33.2	123.1
147	125° F.	82.8	38.3	121.1

Solution Tested: Solution D-2 (Table III).

TABLE VII

EFFECT OF VARIOUS MISCELLANEOUS CHEMICALS

NaCN	*ZnO*	*NaOH*	*Chemical Addition oz. per gal.*	*Per Cent Cathode Efficiency*	*Per Cent Throwing Power*	*Cathode Efficiency Plus Throwing Power*
17.2	8.9	10.9	——	83.0	44.0	127.8
17.2	8.9	20.9	——	91.3	34.9	126.2
17.2	8.9	10.9	15.0 Na_2CO_3	72.7	48.1	120.8
17.2	8.9	10.9	10.0 Na_2SO_4	78.4	45.0	123.4
17.2	8.9	10.9	4.0 $NaHSO_3$	71.7	50.1	121.8

Operating Conditions: All solutions: 92° F. plus or minus 1° F. : 2.8 amps. or 52 amps. per sq. ft. All solutions contained 0.20 grams per liter of Na_2S.

For each result reported in this paper, not less than two tests or runs, each with two sets of figures, were averaged to secure the value reported. Only checks agreeing within 3.0% of the average were accepted, and in the event of a result being thrown out, an additional run was performed. The duration of the tests varied between 15 and 30 minutes. The sample calculations in Table I illustrate the kind of checks obtained. Fresh solution from stock was used for each run in order to eliminate minor changes in solution composition, such as an increase or decrease of zinc content resulting from unequal cathode and anode efficiencies. Stock solutions were prepared from commercial sodium cyanide, zinc oxide, caustic soda, and sodium sulfide, and were filtered and analyzed in accordance with accepted methods of analysis.[2]

One of the first variables studied was the effect of a small amount of purifying agent used to precipitate metallic impurities such as lead, tin, and cadmium. An earlier investigation covering different proprietary purifiers revealed that none was more rapid or efficient than sodium sulfide,[3] which was found to precipitate as little as .01 gram per liter of copper (with mild agitation) in less than one minute. As shown in Table II, the addition of a very small amount of sodium sulfide (.20 grams per liter) produced a fairly large increase in throwing power (11% to 20%) while reducing cathode efficiency 6% to 15%. A larger addition of sodium sulfide further increased throwing power and decreased efficiency, but not as much as the first initial small addition.

The next set of data show the effect of increasing the sodium cyanide content in relation to zinc oxide concentration (Table III and Figure 3). In this case, an increase in throwing power resulted from increasing the concentration of sodium cyanide, and was accompanied by a decrease in cathode efficiency. Per cent cathode efficiency and per cent throwing power are added together in the last column of Table III, and an examination of these figures indicate that the ratio of sodium cyanide/zinc oxide having the maximum additive effect is 1.70. This ratio, however, is outside the bright range at current densities of less than forty amps. per sq. ft., and just inside the bright range for current densities of 50 amps. per sq. ft. or more. Therefore, a solution with a ratio of 1.83 oz. of sodium cyanide per oz. of zinc oxide was chosen as a base for subsequent tests.

The effect of diluting the above 1.83 base solution while adding caustic soda to maintain the caustic content is shown in Table IV and Figure 4. While there was no appreciable change in efficiency or throwing power for this solution as a result of dilution, the second set of figures indicate that such a procedure for a solution with a ratio of sodium cyanide to zinc oxide of 2.40, resulted in a decrease in throwing power and an increase in cathode efficiency. In both cases, as a result of dilution, there was a very slight increase in the set of figures representing the sum of throwing power plus efficiency.

Variation in temperature, frequently ignored in some plating rooms, and its effect on cathode efficiency and throwing power are summarized in Table V. When throwing power is plotted as ordinant against temperature as abscissa, as in Figure 5, a straight line connects the points, with a negative slope of 5% decrease in throwing power per 15° increase in temperature.

In Table VI (Figure 6), the effect of changing current density on cathode efficiency and throwing power is summarized. Increasing the current density resulted in an increase of throwing power and a decrease in cathode efficiency. In this case, the maximum additive effect (efficiency plus throwing power), was found at 52 amps. per sq. ft. for solutions operated at either 92° F. or 125° F.

Finally, the effect of adding particular chemicals to the electrolyte was studied, and the results are listed in Table VII. With a very high concentration of sodium hydroxide present (20.9 oz. per gal.), a greater efficiency and lower throwing power was found than for solutions containing the usual amount of 10 to 12 oz. per gallon. Sodium carbonate, frequently found in zinc plating solutions as a result of cyanide decomposition or absorption of carbon dioxide from the air, was found to reduce efficiency and increase throwing power. The effect of sodium sulfate, the by-product of the re-

2. 1941 Plating and Finishing Guidebook published by Metal Industry.

3. R. O. Hull and C. V. Wernlund, Electrochemical Society Preprint 80-36.

action envolving the removal of carbonate by the use of calcium sulfate, was found to be slightly less than that of sodium carbonate.

It is significant that initial production, operated at 125° F., and using few mechanical or automatic aids, resulted in 11% rejects. After the introduction of the automatic equipment described, operation at 92° F. resulted in 0.5% rejects.

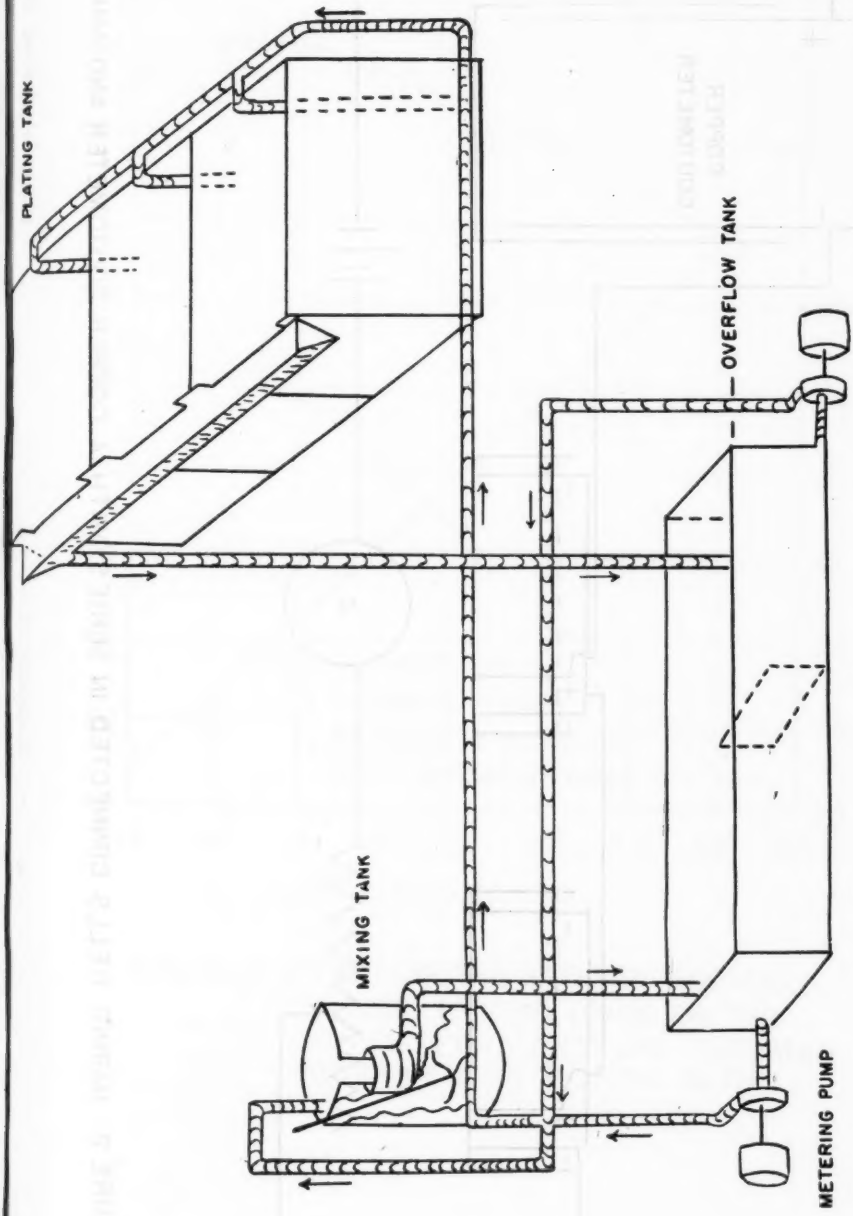

FIGURE 1- DIAGRAM OF SOLUTION CIRCULATION THRU MIXING, OVERFLOW, AND PLATING TANK.

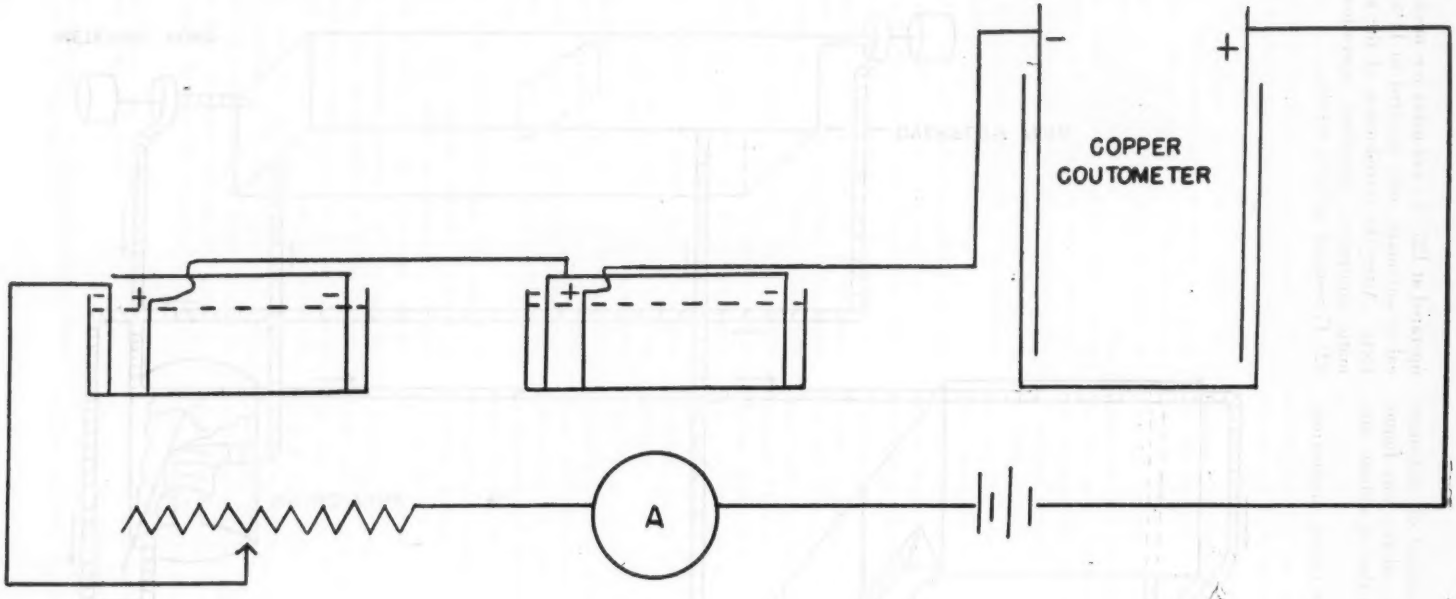

FIGURE 2 - HARING CELLS CONNECTED IN SERIES WITH A COPPER COUTOMETER AND AMMETER.

EFFICIENCY PLUS THROWING POWER

4 5 6 7 8 9 10 11 12 13

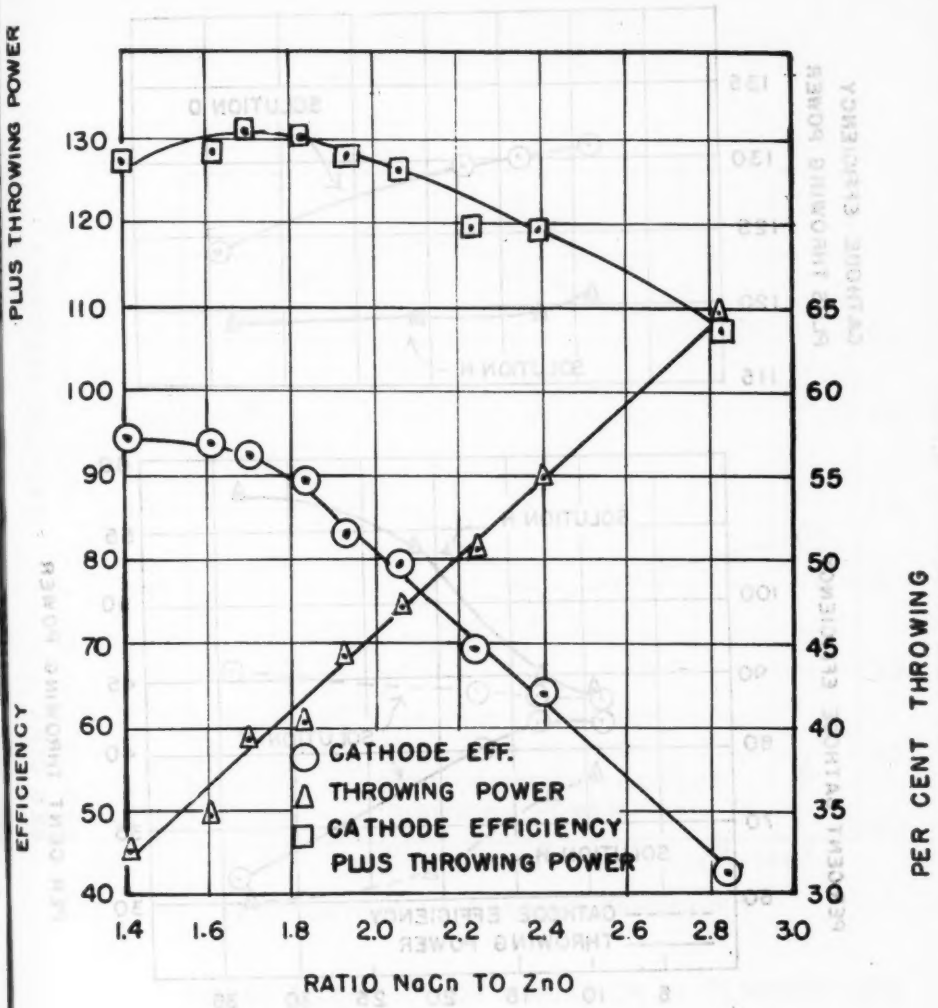

FIGURE 3 - EFFECT OF THE RATIO OF SODIUM CYANIDE TO ZINC OXIDE ON THE CATHODE EFFICIENCY AND THROWING POWER OF ZINC PLATING BATH.

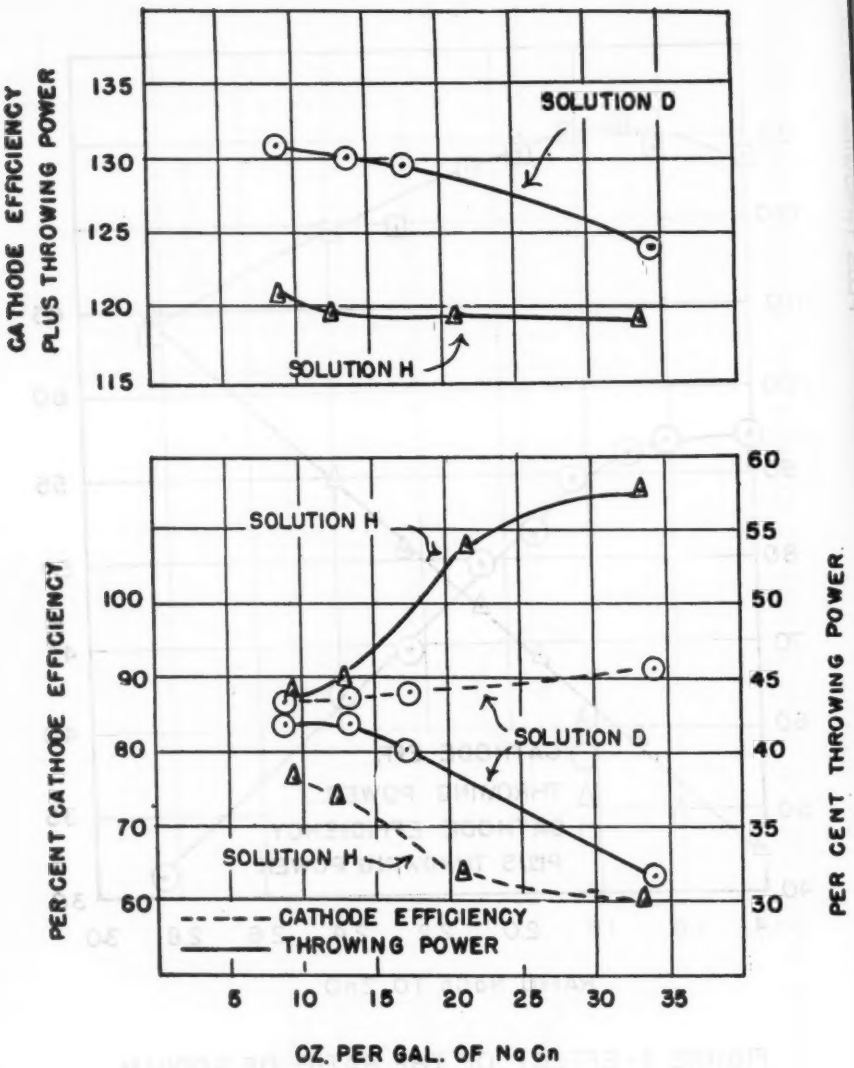

FIGURE 4 - EFFECT OF DILUTION ON CATHODE EFFICIENCY AND THROWING POWER OF ZINC BATHS D AND H AS MEASURED BY SODIUM CYANIDE CONCENTRATION.

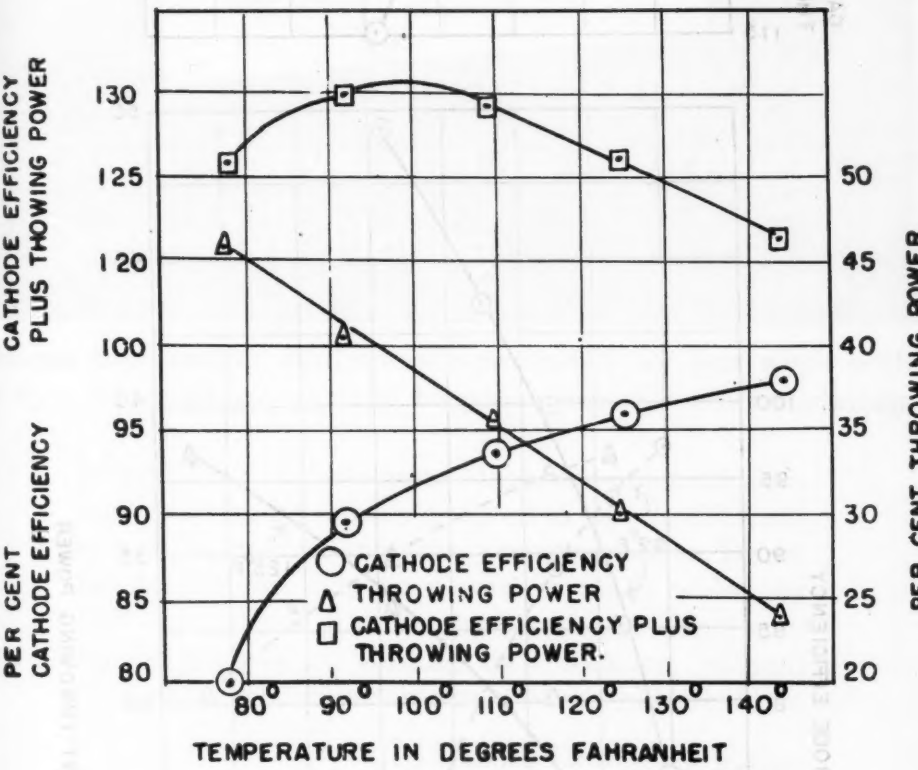

FIGURE 5 - EFFECT OF VARIATION IN TEMPERATURE ON CATHODE EFFICIENCY AND THROWING POWER.

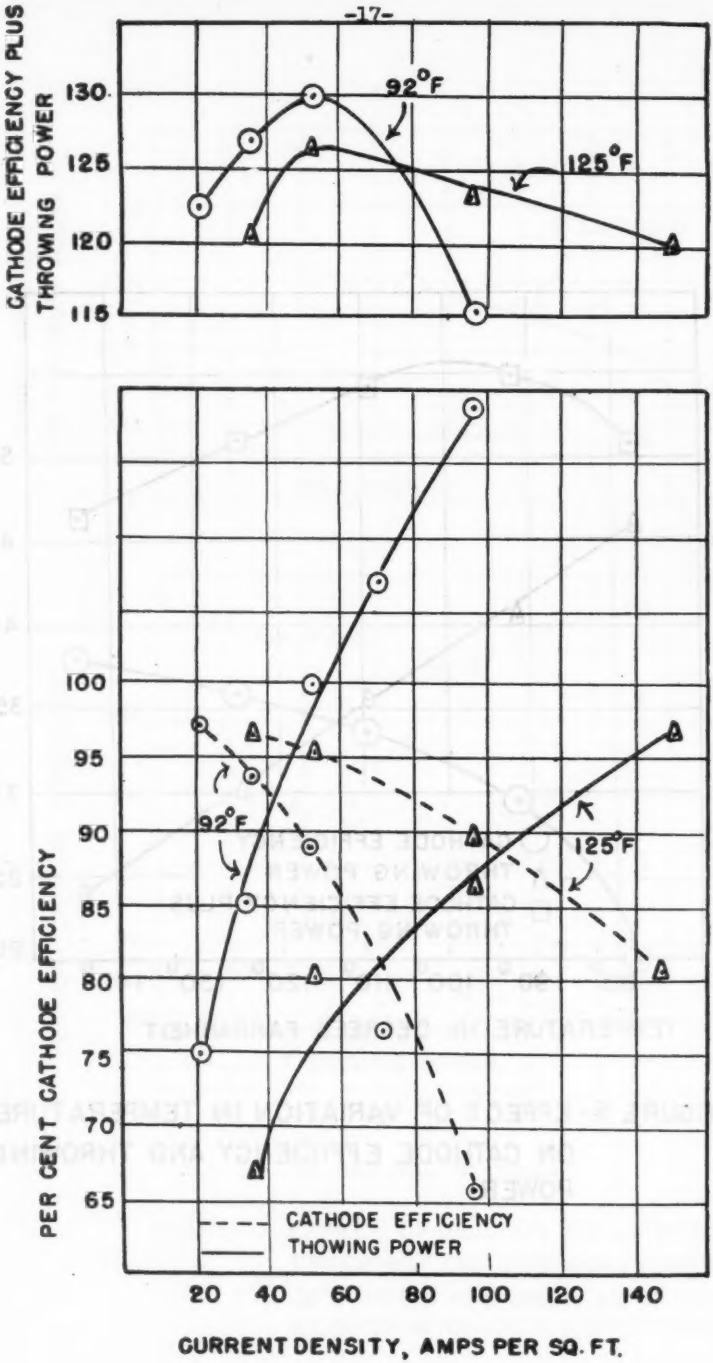

FIGURE 6-EFFECT OF CHANGING CURRENT DENSITY ON CATHODE EFFICIENCY AND THROWING POWER AT CONSTANT TEMPERATURE.

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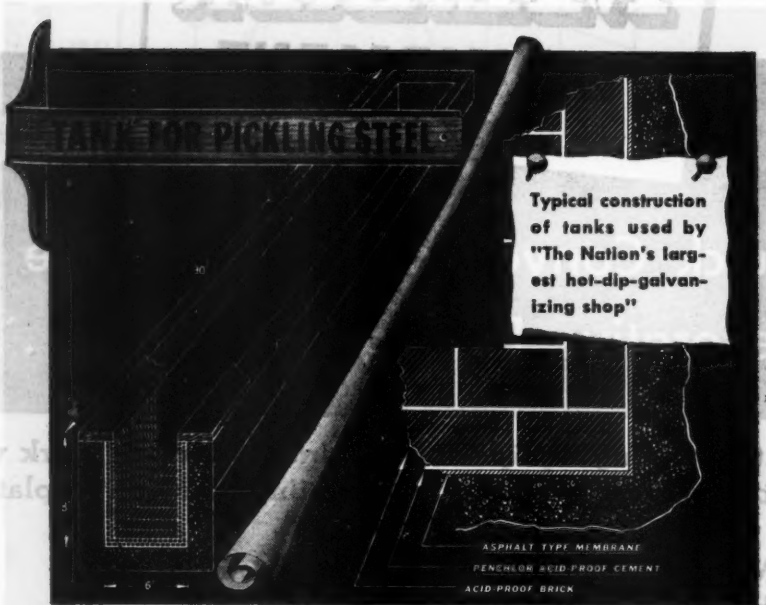
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HARD CHROMIUM PLATING

BY J. J. DALE

HAVING watched with interest for some years the activities of the American Electroplaters' Society, and read many of the excellent papers delivered to its meetings in the United States of America, it is with considerable pleasure, and some trepidation, that I find myself in front of a meeting of an Australian Branch of that Society, about to give an address. The formation of this Branch is a forward step on the part of the New South Wales platers and I wish it vigorous growth and every success as a basis for fruitful cooperation in the field of plating technique.

To get on with my subject, hard chromium plating, I do not need to tell you of the recent rapid growth in the demand for this process, nor do I propose to give a detailed list of its many applications. I will, however, be touching on the general rules governing its usefulness and will be considering some special applications.

The process is not of such recent origin as some might think. The appreciation and use of chromium plate for wear resistance followed closely its first large scale use for decorative purposes, back in the early nineteen twenties. In fact, there was published in 1928 a list of application of hard chromium plating so complete that it might have been written yesterday. The writer was Dr. Blum, of the United States Bureau of Standards, (from which institution, by the way, a large proportion of the worthwhile research on chromium plating has come). This list was the result of a survey of several engineering firms, which indicates that the process was fairly widely used even in those days.

We recognize two main type of chromium plating, hard and decorative. Some refer to the latter as "bright," which it should be, of course, but the term is rather unfortunate since it might imply that hard chromium is not bright, or that bright chromium is not hard. Actually, hard chromium must be bright, and bright chromium is always hard. The thin coatings used to give a permanent bright finish on top of nickel, may appear soft because the nickel is relatively soft and yields to pressure. These coatings are distinctly hard, but there is not a sufficient thickness for the hardness to be appreciated. The same thickness on a hardened steel tool can increase its life many times.

To distinguish further, while in decorative plating a thin coating is plated on to polished nickel for protective purposes, in hard chromium plating a thicker coating (.0001" upwards) is plated directly on to the basis metal, usually steel, for the purpose of resisting wear or sticking, or to reclaim a worn part. The actual coating is

Munitions Supply Laboratories, Maribyrnong, Victoria. Paper delivered to Sydney Branch of the American Electroplaters' Society, 14th March, 1944.

very similar in each case. One could, therefore, use the term "thick" chromium plating instead of "hard," and say that the process consists simply in plating ordinary bright chromium to a definite thickness. Accordingly I will not be taking special care to refer always to "hard" chromium plating throughout the rest of my talk.

Plating Technique

Some platers become familiar with one combination of plating conditions — a certain bath composition, a certain current density and a certain temperature — find these give a certain rate of plating and use them under all circumstances. Such a restriction is unnecessary and may even be unwise. Satisfactory hard deposits may be obtained from baths of different compositions over a wide range of temperatures and current densities. (The literature contains recommendations varying from 100°F. and 50 amp./ft.^{2} to 170°F. and 3000 amp./ft.^{2}). Frequently a set of conditions that is good for one job is not much good for another. Hence the need for a knowledge of the laws governing the changes in plating rate and in the type of plate produced when plating conditions are varied.

As a result of much investigational work these laws are now available in the form of tables and diagrams, which are to be found in plating text books. I shall review them fairly fully before going on to certain aspects not so well covered in books and articles.

Bath Compositions:

Practically all baths in common use are composed of chromic acid, together with a small amount of sulphate (fluorides may take the place of sulphate, but their use is rare). Some chemical must be added to the chromic acid or there will be no yield of chromium, products of electrolysis being merely hydrogen and oxygen. Even with the added chemical, 80-90 per cent of the current is normally wasted in the production of hydrogen at the cathode. Taken in conjunction with the fact that chromium is plated from the hexavalent state, compared with divalent copper or nickel, this means that the yield of metal is about twenty times more in the case of nickel or copper than it is in the case of chromium. Remembering also, all the troubles associated with poor throwing power, burnt and milky plate, etc., it might be wondered whether chromium plating was worthwhile. However, the product has such excellent properties that it is worthwile. Other redeeming features are, the simplicity of the bath, its ease of maintenance, and its intrinsic cleaning properties, which make elaborate pre-treatments unnecessary in chromium plating.

Solutions in common use cover quite a range of compositions. Text books often describe baths having chromic acid contents of 40 and 64 oz. per gallon. Sulphate content, expressed as a ratio chromic acid: sulphate, is normally given as 100:1, the practical limits for this figure being 50-200. For hard chromium plating the lower chromic acid content is recommended, with a sulphate ratio not exceeding 100, the choice for each constituent being influenced by efficiency considerations. The higher chromic acid content, coupled with sulphate ratios of 100 or more, typifies baths commonly used for decorative work. The more concentrated solutions has a higher conductivity; permitting use of low voltage generators which would be unsuitable for hard chromium plating in which higher current densities are required and solutions of lower conductivity are used. It is necessary in this decorative work to have the sulphate ratio not less than 100 in order to obtain good throwing power.

Bath maintenance is a fairly simple matter, consisting largely of making periodic additions of chromic acid, as indicated by density measurements or analysis. Sulphate content should occasionally be checked by analysis. With continual use of lead (or antimonial lead) anodes, the trivalent chromium content should not become excessive, especially if their area is, on the average, greater than that of parts being plated.

Operating Characteristics of Chromium Plating Baths

Bright Range: — The most fundamental of the rules affecting the success of chromium plating operations is that which states that current density must be chosen to suit the particular bath temperature being used. In this respect chromium plating differs markedly from other types in which deposits are produced at current densities ranging down to the very lowest values. Chromium cannot be deposited when the current density is below a certain critical

value, which varies with bath temperature. For any given plating bath composition and temperature there is a range of current densities known as the "bright range." For the production of bright (and therefore, hard) deposits the current density used must be within this range. Currents below this range give "milky" deposits, while currents above it give "frosty" or "burnt" deposits. Variation of the bright range with temperature can be shown by means of two lines on a graph, conditions for production of bright deposits being represented by points between the two lines. Fig. 1 shows bright ranges for baths of two different chromic acid contents (Note: 10 amp./dm.^{2} is equivalent to 93 amp./ft.^{2}). The continuous lines define the range for a bath containing 40 oz./gal. chromic acid (2.5 Molar) and the dotted lines for one containing 80 oz./gal. (5.0 Molar), sulphate ratio being 100 for each.

Considering first the case of the 40 oz./gal. bath, this being that most representative of baths in common use, it can be seen that with increasing temperature, the range as a whole rises on the current density scale and also widens considerably. Higher current densities must be used when the bath temperature is raised, correspondingly higher plating rates being obtained.

In actual plating practice another important factor is involved, namely, current distribution. Current density varies considerably over the surface of an article being plated, according to its shape and arrangement in the bath. Thus, in order to obtain a bright plate over the whole of the article, the current density at every point must be within the bright range. This can occur only when the ratio of maximum to minimum current densities on the article is less than the ratio of the limiting current densities for the bright range. This latter ratio can be just as important, therefore, as the numerical width of the bright range. Certain plating text books treat this aspect in some detail.

Comparison of the dotted and continuous curves in Fig. 1. shows the effect of doubling the chromic acid content. At the higher concentration the bright range rapidly becomes narrow as temperature is raised beyond a certain figure, and finally closes at 53°C. (127°F.). The range for the 40 oz./gal. bath also closes eventually, but at a much higher temperature, 70°C. (158°F.). Above this "closing" temperature the "milky" and "burnt" zones merge and, whatever current density is used, deposits obtained are all grey, intermediate in colour between the milky and burnt deposits produced at lower temperatures. Milky deposits become darker as plating temperature is raised towards the figure at which the bright range closes.

Closing of the bright range can be prevented by reducing the sulphate ratio to 75 or 50 in which case bright deposits may be obtained over a wide range of current densities at temperature of 70°C. (158°F.) and over. (This refers to the 40 oz./gal. bath).

As a final observation on types of plate I would like to state my contention that really burnt-looking deposits (such as decorative platers would produce with too high a current density at about 100°F.) are practically never met with when plating temperatures are in ranges commonly used for hard chromium plating, (120-140°F.). At these temperatures, products of too high a current density may be either "frosty" plate, if current is uniform, or more commonly, growths or "treeing" at edges and corners. Surfaces of nodules forming "trees" are normally bright, although the current density on these nodules must be high.

Efficiency: We have seen that in normal chromium plating only part of the current is utilized in depositing metal, the remainder being wasted in producing hydrogen. The efficiency of a chromium plating bath under certain conditions of current density and temperature can be defined as that proportion of the current which deposits chromium, expressed as a percentage of the total current. It can be measured by weighing the deposit obtained with a certain current and dividing this by the weight which would be obtained at 100% efficiency (known from Faraday's Law of Electrolysis). The efficiency is of importance to the plater in that, taken in conjunction with current density, it decides what the plating rate will be. Likewise its variations with plating conditions are also important.

Fig. 2 shows how efficiency varies with current density at three different bath temperatures (note that temperatures are Centigrade).

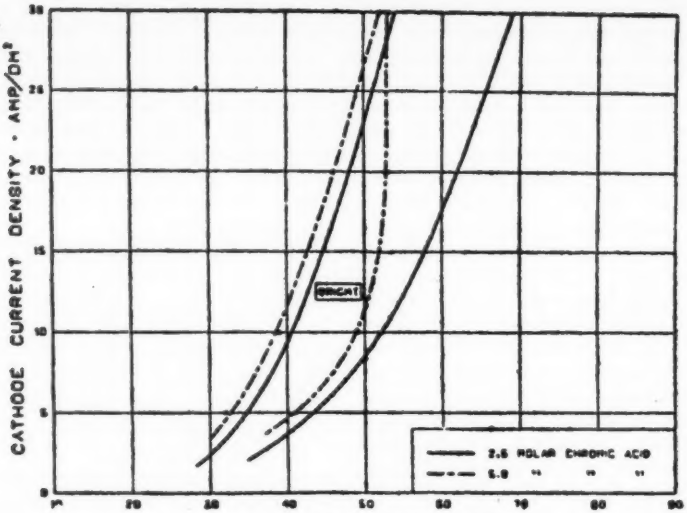

Fig.1. Variation of "bright range" with temperature[4].

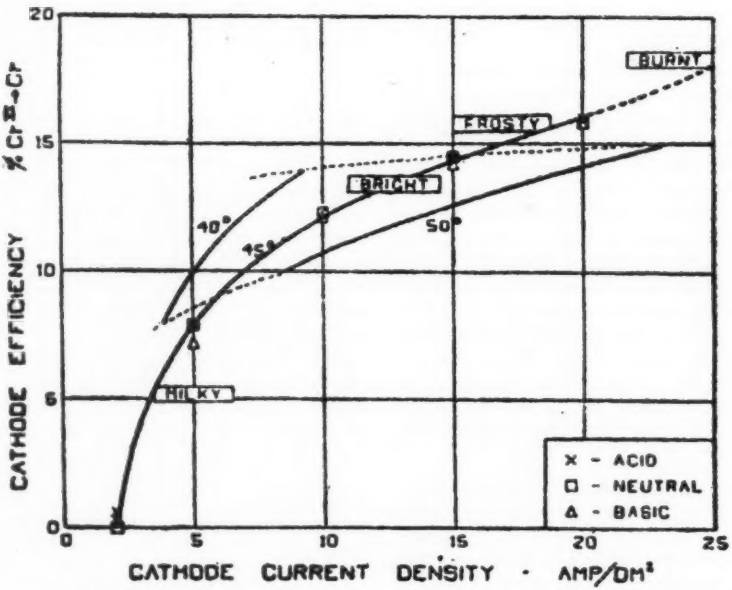

Fig.2. Effect of current density on efficiency[4].

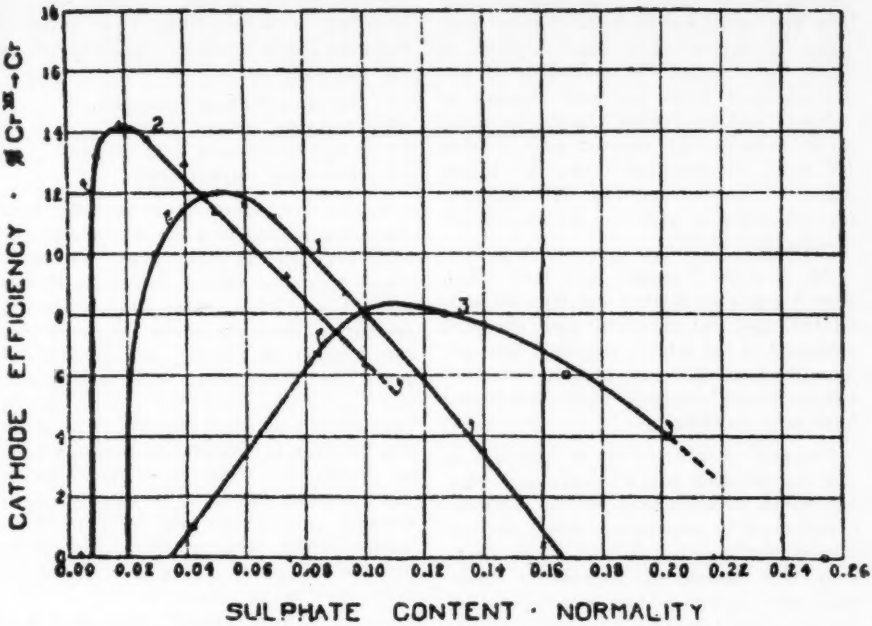

Fig.3. Efficiency vs. sulphate curves for various CrO3 contents[4].

Bath temperature : 113°F

Current density : 93 amp/ft.^{2}

CrO3 content : Curve 1 40 oz./gal.
2 12 oz./gal.
3 80 oz./gal.

The following points will be noted: —

(1) For a given temperature the efficiency rises as current density is increased.

(2) For a given current density the efficiency falls as temperature is increased.

(3) The efficiency increases less rapidly as current density is increased at a constant temperature; in other words, the curve tends to flatten out. Conversely, the efficiency falls off very sharply when currents are reduced to low values. This, as we shall see, has considerable bearing on the poor throwing power of chromium plating solutions.

Aspects of variation of current efficiency with bath composition are shown in Fig. 3. The curves show that for a given chromic acid content, temperature and current density there is a certain optimum sulphate ratio giving maximum efficiency, increasing or decreasing the ratio results in a fairly rapid falling-off in efficiency. They also show that higher maximum efficiencies are obtainable with lower chromic acid contents. A normality of .05 N. corresponds roughly to a sulphate content of .4 oz./gal. so that the peak in curve No. 1 (40 oz./gal. chromic acid) occurs at a sulphate ratio of 100, the figure most favoured in practice.

Considering only curve No. 1 (the others are for compositions outside the range of those normally used) we have found that as the temperature is raised the peak moves to the right, i.e., towards lower sulphate ratios.

These curves also illustrate some of the tendencies which in practice impose lim-

itations on the chromic acid contents used. The low efficiency of high chromic acid baths is shown, while the steepness of curve No. 2 reveals the sensitivity of low chromic acid baths to small changes in sulphate content. (Other reasons for using about 40-50 oz./gal. chromic acid are that for more concentrated baths the bright range is narrow (see Fig. 1) while for less concentrated baths the bath resistance becomes too high).

All of these diagrams have been taken from a paper by Haring and Barrows, dated 1927 and still about the most thorough treatment of the subject available, although more modern tables of plating rates and efficiencies under various plating conditions have been published.

Throwing Power: — It is well known that the throwing power of chromium plating baths, as evidenced by the difficulty experienced in depositing chromium uniformly over recessed articles, is extremely poor. One method of determining throwing power involves plating onto two similar sheets of metal on opposite sides of a common anode, one sheet being twice as far from the anode as the other. (It does not necessarily follow that current to one sheet is twice that to the other). The throwing power is the percentage variation of the ratio between weights of deposits from the ratio 2:1; it is positive when the farther sheet receives more than half the deposit on the nearer one and negative when it receives less than half.

It can be seen from the above definition that throwing power is a function of change in efficiency with current density under plating conditions chosen. This change differs considerably from one type of plating bath to another. In cyanide copper plating, for instance, the efficiency falls as current density is increased and the throwing power is good, ranging from +20% to +40% on the scale outlined above. In nickel or acid copper plating, where the efficiency is practically constant, the throwing power is moderate, being zero or slightly negative. In the case of chromium plating, however, the efficiency falls rapidly as current density is decreased and values of throwing power are always negative. In one investigation the best throwing power measured was —13%, other values ranging down to —350%. Also in this investigation that variation of throwing power with major plating variable was determined, it being found that improved throwing power could be brought about by the following steps: —

(1) Lowering bath temperature.
(2) Increasing current density.
(3) Lowering chromic acid content.
(4) Increasing sulphate ratio.

In the temperature range used for hard chromium plating, step No. 4 would reduce efficiency; all the other steps increase it. These principles cannot always be directly applied in practice, because this method of measuring throwing power does not take into account such things, as "burning" of plate when temperature is too low or current too high. Need for smooth bright plate at all points will limit the steps which can be taken to improve the throwing power. Furthermore, the above investigation did not cover the range of plating conditions in present day use for hard chromium plating, and certain results given later on this paper may appear to conflict with some of its conclusions. Other criticisms have from time to time been levelled at this method of measuring throwing paper. The chief objection, as I see it, is that the definition is based on distances rather than on actual current distribution, which is the major factor controlling distribution of deposit.

Practical Considerations

Current Distribution: — Successful application of the principles outlined above, to ordinary plating practice, depends largely upon proper allowance being made for that most important factor, current distribution. This factor has already been mentioned (see under "Bright Range"), but requires consideration in more detail. It is the basic cause of that troublesome variation in deposit thickness, occurring in all types of plating, but most marked in the case of chromium plating because here the uneven current distribution brings into play the notoriously poor throwing power of the chromium plating bath.

The following factors affect current distribution:

(1) *Shape of article.* Current tends to be concentrated at points, edges, high spots and at boundaries of stopped-off areas. It is greatly reduced in recesses, angles and low spots.

(2) *Anode arrangement.* Current at various points on the object varies as the distance from the anode; also with the relative area of anode adjacent to different parts of the object.

(3) *Other racking or jigging arrangements.* B leeders, shields and screens can alter the flow of current, and, in particular, can be used to reduce the current to points, edges and high spots.

(4) *Plating conditions.* Little data is available, but the indications are that current distribution is less uniform as temperature is raised with corresponding increase in current density.

A most detailed treatment of current distribution is to be found in a series of papers by Dr. Charles Kasper of the United States Bureau of Standards.

Variation in Thickness of Deposit: — Perhaps the simplest case of uneven current distribution causing variation in deposit thickness would be that of a flat-ended solid cylinder hung vertically in the plating bath. All platers know that the deposit is thickest around the lower edge. Here only the "shape factor" is involved; effect illustrated could be called the "edge effect."

A more complex example, still involving only the "shape factor," is shown in Fig. 4. Imagine a flat bar, with a semi-circular groove along its length, hung vertically in the plating bath with the groove opposite a flat anode. The figure is intended to be a cross-section of such a bar after chromium plating, the darkened portion showing in exaggerated from the distribution of deposit which might be expected. In order to analyse this case in the light of the principles outlined above I have assumed figures for current density at various points, together with corresponding efficiencies, and have calculated the resulting relative thickness they would be approximately correct for a bath temperature of 112°F. and an average current density of 200 amp./ft.^{2}. It will be seen that while the current densities in the groove, on the flat face and on the sharp edge respectively are in the ratio 1:2:4, the thicknesses of deposit at these points are in the ratio 1:3:7.

The distribution of the deposit for the above case will hold only for the plating conditions stated. It would be different for another set of plating conditions and could conceivably be much worse.

Interesting information as to the effect of variation in plating conditions on the distribution of the deposit over non-uniform objects was obtained from some laboratory experiments we carried out on the chromium plating of screw threads. One inch diameter cylinders threaded over the lower ½" of their length were fixed centrally inside a 3½" diameter anode, also ½" deep. The plating bath contained 48 oz./gal. chromic acid, with sulphate ratio 100. Diameter measurements at the crests and at the roots of the threads, were taken before and after plating. These were averaged over the full length of thread and the ratio, average thickness at crests; average thickness at roots, was taken as a measure of uniformity of deposit thickness. Table 1 gives this ratio for a number of different temperatures and current densities. The current densities for each temperature are the highest that can be used without the deposit on the crests becoming rough. Time of plating was adjusted in each case to make the thickness at the roots .001"—.0015".

TABLE 1

Variation in Thickness of Deposit on Screw Threads

Specimen No.	Plating Conditions		Thick. at Crests Ratio
	Temp.	Cur. Density	Thick. at Roots
1	122°F.	200 amp./ft.^{2}	5:1
2	131°F.	350 amp./ft.^{2}	8:1
3	140°F.	500 amp./ft.^{2}	11:1
4	150°F.	750 amp./ft.^{2}	16:1

It can be seen that the coating becomes less uniform in thickness when higher temperatures, and higher current densities are used. (The average plater would quite rightly describe this trend as a reduction in throwing power. I have avoided using the term here, however, since, as defined above, throwing power is based on relative distances from the anode, whereas in this case the "shape factor" predominates). These results also illustrate how the current distribution changes with plating conditions. If the current distribution for specimen No. 4 had been in the same ratio as it is for No. 1 then the deposit on No. 4 would have been a great deal more uniform.

Thickness variation over the complete thread form for specimens No. 1 and No.

4 is shown in Fig. 5, which has been constructed from micro-photographs of polished cross-sections. Note the excessive "build-up" on the crests of specimen No. 4, also how the threads lowest in the bath (on left for No. 1 and on right for No. 4) have been plated to a greater thickness than the rest.

Most Suitable Plating Conditions for Various Types of Work: — A wise choice of plating conditions to suit certain types of work can effect great saving of time as well as improving the general standard of work. The wisest choice, however, will be of no avail if process control is poor. Bath composition must be watched, temperature and current accurately controlled. A certain current density, being chosen, the current must be based on the area to be plated (this should be limited as far as possible by stopping-off areas not requiring any coating). Most areas can be readily calculated. Complicated shapes can be divided roughly into standard geometrical shapes for which simple formulae for area calculation are available.

Work is submitted for hard chromium plating varies in many respects, of which the following have most influence on choice of suitable plating conditions:

(1) Thickness required.

(2) Shape of article.

(3) Surface finish required (whether it is to be reground or used in the as-plated condition).

With work roughly classified according to this list the following general recommendation can be made.

Parts which are to be reground and require a fairly thick coating, can be plated at high temperatures (130-140°F.) and high current densities (300-800 amp./ft.^{2}) when advantage may be taken of the fast plating rates obtained under these conditions. When shape is favourable to uniform current distribution the temperature and current density can be further increased and really high plating rates obtained: for example, 1500 amp./ft.^{2} at 145°F. gives .005"/h. and this is by no means the limit. At temperatures of 130-140°F. a sulphate ratio of about 75 will give the greatest efficiency. Lower currents must be used where shape causes poor current distribution and consequent tendency to "treeing" at the edges. This tendency grows worse as higher bath temperatures and correspondingly higher current densities are used and, when heavy deposits are required, it can be sometimes become so bad that the "trees" take nearly all the current, the remainder of the deposit becoming milky and plating rate falling off to a very low value. Current distribution can be greatly improved by skilful racking.

For parts requiring only a thin coating and certain parts needing thicker coatings yet not to be reground, also where maximum uniformity of thickness is wanted on a non-uniform shape we have found the following conditions suitable: — temperature 122°F., current density 200 amp./ft.^{2}, sulphate ratio 100. In the experiments on screw threads described above it was conclusively demonstrated that these conditions give least variation in deposit thickness. The slow rate of plating obtained (.0006"/hr.) is little disadvantage when thickness required is small. Examples of work for which these conditions are suitable are cutting tools, drawing dies and gauges which it is proposed to reclaim without regrinding.

A plant to handle work according to the above scheme would therefore consist of two baths, operated as follows:

A. Sulphate ratio 75, temperature, say 140°F. Use for thick deposits and rough work generally.

B. Sulphate ratio 100, temperature 122°F. Use for thin deposits, complex shapes and precise work.

This advice must not be taken as binding for all cases. Certain thin deposits (for example, on tools of simple shape) can be applied equally well in either bath. Again, bath B can be used for thick deposits, provided ample time is available, and it actually provides better uniformity. We frequently use this bath when we leave things plating overnight for thicknesses of .006"-.008".

When only one bath is available, it could be operated at a sulphate ration 90-100, temperature and current density being varied to suit the job on hand.

Racking and Anode Arrangement:

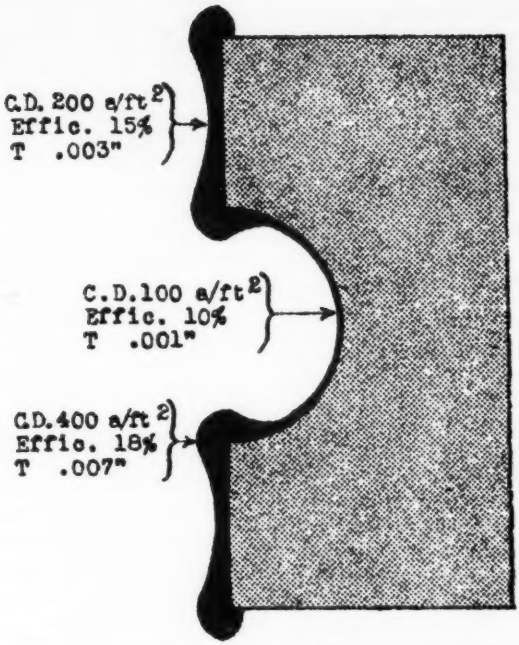

Fig.4. Distribution of deposit over a semi-circular groove in a solid bar.

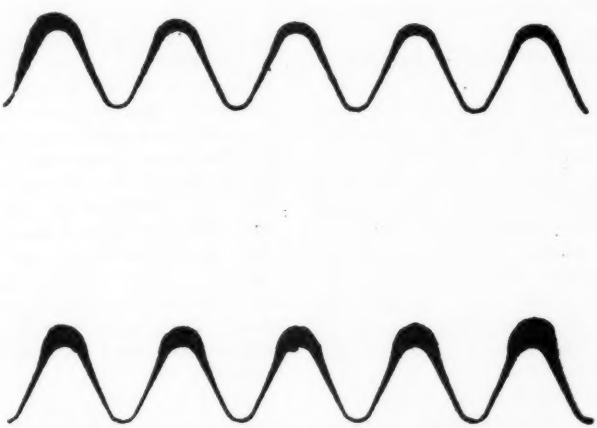

Fig.5. Chromium deposits on screw threads. (magnification x8)

Top Specimen No.1, plated at 122°F., 200 amp./ft.²

Lower Specimen No.4, plated at 150°F., 750 amp./ft.²

A feature of most published recommendations covering hard chromium plating is the emphasis laid on necessity for special racking of work. This is yet another respect in which this type of plating differs from others.

The extent to which special racking is desirable depends on the complexity of the work. The simplest of jobs, for instance plug gauges, can even be done by the orthodox method of hanging them on a central cathode bar, between two rows of anodes. However, it is generally necessary to fix anode and cathode in definite positions relative to one another before introducing either into the bath; the fixture, or jig, as it is called, is then lowered until parts to be plated are complete immersed. Text books illustrate multiple jigs for routine plating of large quantities of standard types of gauges; but for much of the wide variety of work normally met with the plater must rely on his own ingenuity.

The aim of "jigging" is to overcome or minimize the unfavourable current distribution which would otherwise prevail. Steps taken are directed either towards reducing current flow to portions of the object which would normally receive excess deposit, or to directing the current into areas otherwise receiving too little. A few examples will illustrate some of the ways in which current distribution can be modified.

A. *Steps taken to reduce current to certain parts.*

(a) Adjustment of relative positions of anode and object.

A common device consists of having the bottom edge of a cylindrical article projecting well below the lower edge of its circular anode. In the converse case of an internal cylindrical surface being plated with a centrally placed anode, the lower edge can be protected from excessive deposition by raising the anode a short distance from the lower edge; the top edge may similarly be protected by stopping off the anode for some distance past the edge. These methods are very useful in the plating of drawing dies with sharp edges.

(b) *Use of "bleeders" and "extension pieces."* Most platers are familar with the piece of wire, called a "bleeder," led along parallel to a sharp edge, the idea being for it to take the excess deposit and thus protect the edge. The method is effective, but wasteful; furthermore, it makes it hard to judge how much current is going to the object. Another form of "bleeder" is the "extension piece" by which I mean a piece specially constructed to fit flush with a sharp edge on the object and to form a continuous extension of the surface being plated. While still being wasteful, this permits fairly accurate assessment of current density. It is a very effective method of protecting edges and is a feature of most set-ups described for the plating of cylinders of internal combustion engines.

(c) *Use of shields or screens.* An excellent method of protecting an edge is to interpose a screen between it and the anode, forcing the current to go around the edge of the screen. The screen must be made of an insulating material not attacked by the solution. Glass is best, but is difficult to work. Celluloid is easy to work, but does not last long. Screens will be used more when some of the newer chemically resistant plastics become available.

B. *Steps taken to increase current to certain parts.*

(a) Much can be done to improve current distribution by shaping the anodes to conform to the shape of the work. Diagrams of several of these conforming anodes are to be found in a book by Freeman and Hoppe.

(b) The "octupus" anode, described by Logozzo, has great possibilities. Originally designed for use in the plating of moulds of complex shape, it consists of a large number of thin strips of lead welded on to a solid rod. The strips can be bent to suit the shape of the mould. We have used one of these in the plating of multiple hole dies; also for multiple punches, a lead wire being led around each pillar. Plating time was halved in the case of a flat rectangular surface when a large flat anode was replaced by a lead wire, bent so as to run along close to the middle of the surface and turned up some distance from the ends.

(c) For a die having a circular groove of cross-section ¼"x¼" we have used a cylindrical anode made from terne plate. This material consisting of steel sheet coated with lead alloy, was rigid enough for the anode to be inserted right into the groove without danger of it touching the sides.

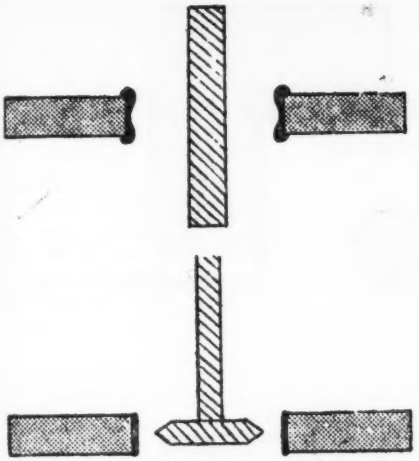

Fig. 6. Improvement in distribution of deposit on ring gauge brought about by change of anode design.

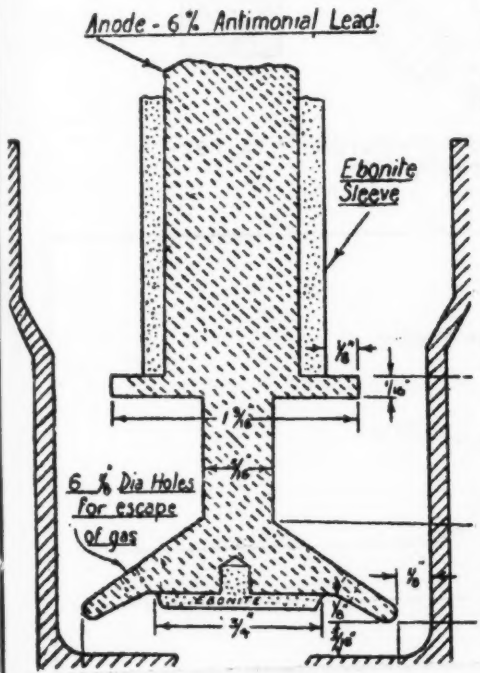

Fig. 7. Special anode designed for plating of cylindrical component.

(d) Another special case is an anode designed for a ring gauge. Fig. 6 diagrammatically illustrates the improvement obtained by using it instead of the more orthodox piece of lead tubing.

This idea was given to me by a Melbourne plater.

(e) Fig. 7 is from a drawing of a special anode designed for plating inside a cylindrical component having a row of holes around the wall and a hole in the bottom. The design embodies more than one of the principles outlined above. Note how the anode is led into the corner, also how it is masked off on the bottom and is set back opposite the holes in the walls so that excess deposit will not be formed on the edges of the holes in bottom and walls. This anode was developed after many experiments and has given excellent results.

(f) Fig. 8 deals with the special problem of plating uniformly the sides of a right angle. The idea comes from one of Dr. Kasper's papers and I have included it because it illustrates some interesting principles. The top left diagram shows what would occur with a solid cylindrical anode hung near the corner. The thickness of deposit on each side falls off rapidly as the corner is approached. This is partly due to the portion of one side near the anode "shading" or "robbing" deposit from that part of the other side nearest the corner. A solution to the problem is shown (top right); it involves stopping off one side and so preventing this "shading." A much more uniform thickness is then obtained on one side only. The next step is to stop off the plated side and plate the unplated side. This method will also work if the corner has a fine radius, but as the radius is increased a stage will be reached (lower left) when the "edge effect" of the stopping off will become operative and excessive build-up of deposit will occur along the edge of the stopping-off. The lower right illustration shows what might be a more conventional way of tackling the problem; a fine wedge shaped anode is arranged with the point as near as possible to the corner.

(g) For the plating of the inside surfaces of large hollow objects there is no reason why one should not do for chromium plating what has been done for nickel,

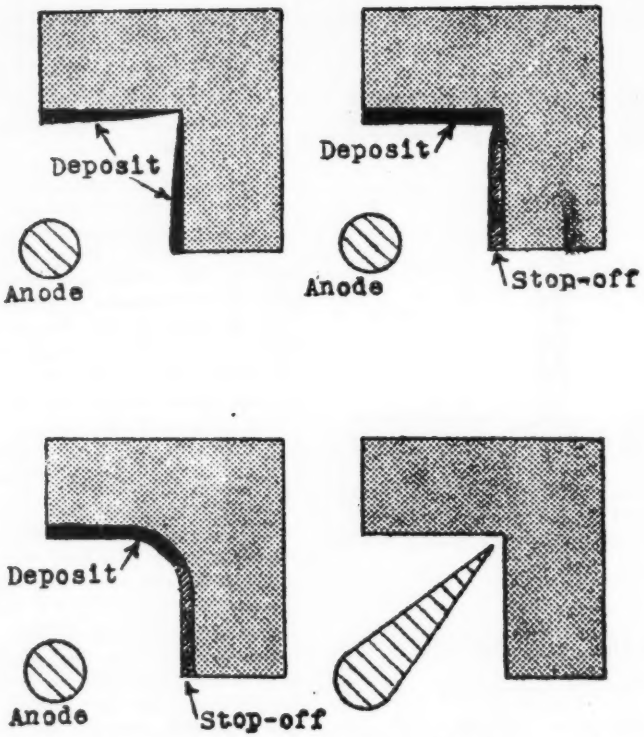

Fig.8. Deposition of chromium in a rectangular corner.

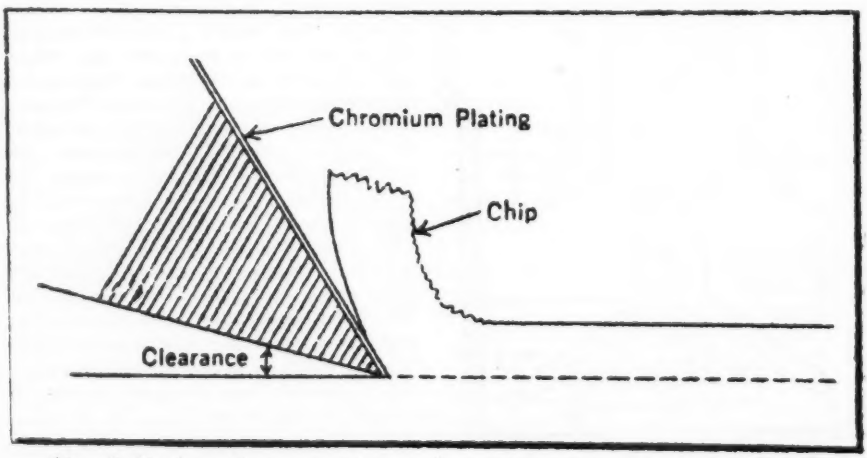

Fig.9.Mode of operation of a chromium plated cutting tool.[12]

copper and other types of plating, namely, close the bottom (if necessary) fill with solution, insert an anode and plate; the object acts simultaneously as tank and cathode.

Pre-treatments for Various Basis Metals

Most of the parts submitted for hard chromium plating are made from either plain carbon steel or low alloy steels. For such basis metals the well-known anodic etch in the plating bath will consistently give good adhesion of chromium to steel. However, some of the more unusual basis metals, notably cast iron and certain complex alloy steels, will not respond to this treatment in its usual form. The literature gives very little guidance as to the best methods of treating such metals. I have, therefore, prepared the following list, giving details of treatments known to have been used with success for the particular metals concerned, although not necessarily the best for any case. There is need for a systematic investigation of this aspect of the subject.

(a) *Plain carbon and low allow steels:* — Make the article anodic for a short time in the plating bath (or a seperate chromic acid bath). The time is not very critical provided it exceeds a certain minim minimum;; we use 2 minutes at 200 amp./ft.^{2}, or its equivalent in ampere-minutes at higher current densities. It is generally convenient to anodize at the plating current and to use a reversing switch so that plating may be commenced without delay.

(b) *Nickel Plate:* — Do not anodize. Treat as for decorative chromium on nickel, viz. commence plating with a very low current and slowly increase it to the plating value.

(c) *High Speed Steel and Stainless Steel (including 18/8):*—

Anodize as for plain carbon steel, reduce current to one eighth of plating value, reverse, raise to full plating value after about five minutes.

(d) *Chromium Plate:* — As for High Speed Steel, but the current need only be reduced to about half the plating value before reversing. Anodizing time should be reduced if the existing deposit is very thin.

(e) *Cast Iron:* — Anodize at four times the plating current for a very short time (not more than 2 seconds), reverse, and "strike" at four times the plating current; reduce to normal plating current. (A very strange phenomenon has been noticed in plating some cast irons. Chromium is deposited until a thickness of about .0001" is obtained when the surface seems to become passive and no further deposition takes plate. As remedy for this is to remove the article from the bath, polish the plated surface, and then treat as in ("d" above).

(f) *High chromium-high carbon die steel:* — This type of steel is much favoured as a die steel and so occasionally a die made from it is submitted for chromium plating. Judging by its composition, (it contains about 12% chromium and 2% carbon), it would seem to need a combination of methods (c) and (e), which is an impossibility. Most erratic results have been obtained from attempts to plate this steel. While sometimes a satisfactory deposit may be obtained by method (a) or (c), more common results are neither no deposit or a deposit which is badly pitted or else flaking from the basic metal. It is generally best to advise that the die be made from some other steel if chromium plating is desired. (This steel can often be plated, although with only moderate adhesion, by a method we refer to as "prenickeling." First described by Gardam, it consists of plating for 5 minutes at 200 amp./ft.^{2} in a bath containing 38 oz./gal. Nickel Sulphate and 8 oz./gal. Sulphuric Acid; temperature 95°F. Using this method we were able to plate successfully some rubber cutting tools made from this steel. Incidentally, this method makes it possible to deposit nickel over chromium plate).

Use of Hard Chromium Plate

While space will not permit anything in the nature of a comprehensive listing of applications for hard chromium plate, I would like before closing to give a few words of advice on the general subject of the use of this material. Considering first the cases of a few well established applications, the following points should interest both plater and user.

Gauges: — To take a plug gauge as an example, it is generally considered best to grind .004" undersize before plating, rather than to immediately build up a worn gauge. The gauge should then be built up by at least .008" on diameter, leaving .004" as grinding allowance. Ex-

perience has shown it to be unwise to leave less than this amount for grinding. Sharp corners should be rounded off, where possible, to minimize the risk of chipping of the deposit.

Cutting Tools: — Cutting tools, are best plated in the fully hardened, fully sharpened condition. A very thin coating (.00005") is usually sufficient; there is little risk of chipping at this thickness. The deposit is usually needed only on the "chip-bearing" face and plated tools may be sharpened many times by grinding faces which intersect this face (see Fig. 9.)

Drawing Dies: — Dies should be given the best possible surface finish before plating. The most suitable thickness is about .0005"-.001". Dies submitted for plating should preferably not be fully hardened; there is less risk of cracking of the die during plating if it has been softened slightly by tempering, but the hardness must still be sufficient for the die to withstand pressures encountered in service. A cheaper steel die can often be used when the die is to be plated. Jevons has given a very good treatment of the whole subject of chromium plating of drawing dies.

For a large variety of miscellaneous repair jobs, the procedure to be followed will depend on the details of the particular job on hand. Relations between platers and users of hard chromium plate will not be improved by misunderstandings as to thickness required, whether figures quoted are for diametral or thickness increase, or whether grinding allowance has been allowed for. Similarly, platers will not be pleased if complex alloy steels are submitted without a warning as to their composition. An English firm takes no chances and requests the following, in writing, before quoting for a job.

(1) Dimensioned sketch of part.
(2) Composition of basis metal.
(3) Structural condition (annealed or heat treated).
(4) Amount of diametral wear.
(5) Thickness of deposit required.
(6) Final grinding tolerances. (Grinding is done by the firm.)

Platers are frequently in a position to make suggestions to their customers regarding possible new uses for hard chromium plating. In extelling the virtues of this material it is as well not to make claims that are too extravagant. The following points may be worth noting. Electrolytic chromium is not the hardest metal. It is harder than glass and ordinary tool steels but is not as hard as nitrided steel or tungsten carbide; furthermore, it is not as hard as high speed steel at high temperatures. These short-comings are compensated for by other properties, notably, low co-efficient of friction and lack of tendency to seize. (For a fuller consideration of properties, I can refer you to the various text books, also to a paper given to a branch of the Australian Institute of Metals.)

Returning to the subject of possible new uses for hard chromium plating, circumstances in which it has been of most value can be classified thus: —

(1) Wear, sliding, rubbing, abrasion.
(2) Sticking and seizing.
(3) Corrosion (e.g. dies for plastics).
(4) Blunting of cutting edges (particularly rotary cutting tools and tools for cutting non-metallics such as rubber, plastics, carboard, etc.).

Parts subjected to shock are generally less likely to benefit from chromium plating.

With certain applications, such as twist drills, success is practically assured. Nevertheless, any new application should be approached with a certain amount of caution, for there have been several cases of failure of chromium plating when it might confidently have been expected to succeed; lathe tools are an example of this. It would seem wiser, therefore, to suggested a trial rather than to guarantee an improvement. Considerable guidance is to be had from the increasing number of publications on the subject.

In concluding, I rather feel I should apologize for having merely touched on so many important aspects of the subject, without stopping to give them the consideration they deserve. I am conscious also of much that has been omitted. However, I trust that what has included will be of some assistance.

I must not close without mentioning the excellent spirit of co-operation existing among platers, exemplified by the Melbourne plater who provided me with most of the details of the pre-treatments for different basis metals listed, and placed no restriction on their publication. Many others have helped me by giving freely of their

(*Continued on page* 619)

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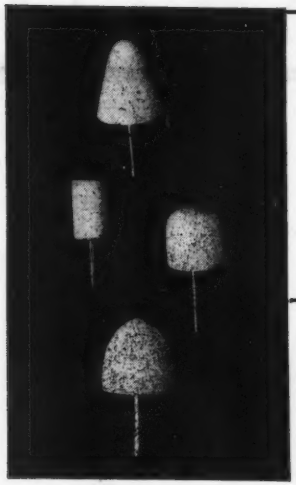

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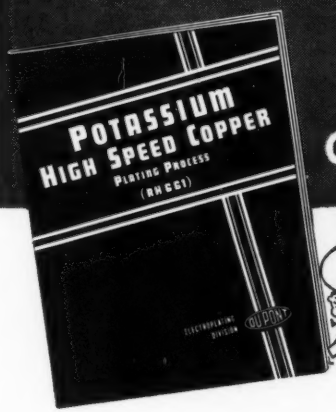

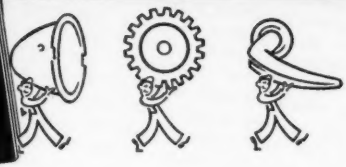

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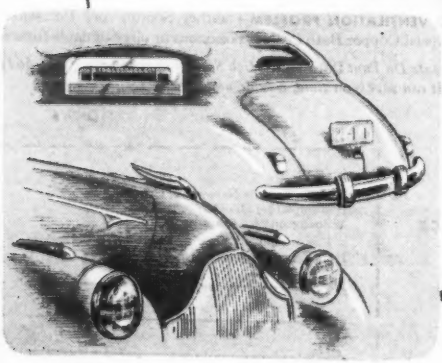

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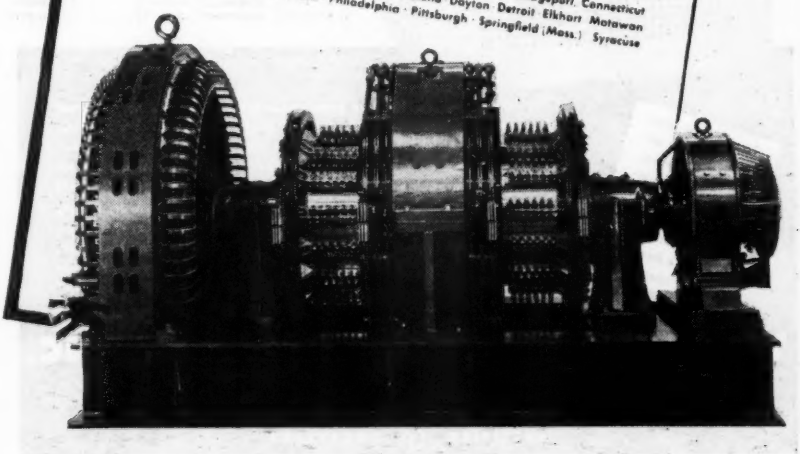

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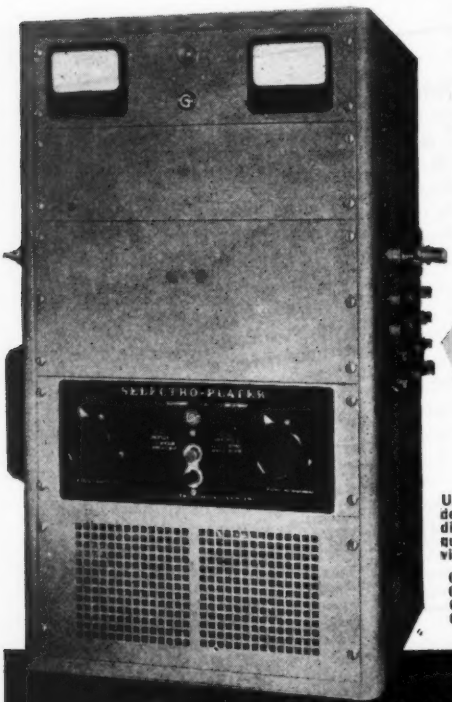

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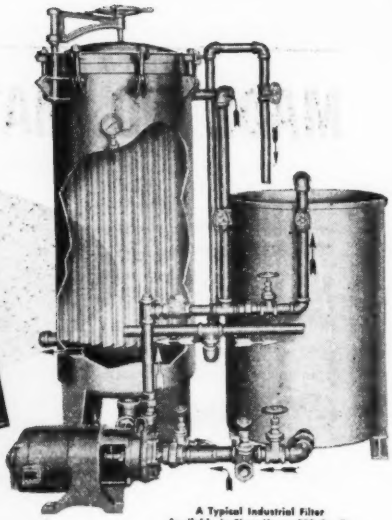

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Salute to Frank Hanlon

One of the truly beloved "old timers," Frank Hanlon passed away March 27th from a cerebral hemorrhage.

Frank was a member of the old National Society and transferred his membership to Chicago from New York when the American Electroplaters' Society was formed. First as a charter member of the Chicago Branch he successively held every office in the Branch and later won the same honors in the American Electroplaters' Society National body.

Frank served as Editor of the REVIEW in 1930 and was the life secretary of the Past Presidents' Law Committee.

Frank Hanlon was a bulwark of strength in the National Society and was a delegate or alternate to twenty-five conventions.

With his brother Jim, Frank formed the Chicago City Plating Company twenty-seven years ago and his association with plating covered almost a half century.

Words in an obituary are empty drum beats when measuring the vast contributions of a man like Frank Hanlon. He was unselfish in his devotion to the Society and the industry.

The cheer, the strength, the warm friendliness which was Frank Hanlon has left a real void in the A.E.S. family. You will be missed, Frank and it will be a long time before we can adjust ourselves to our loss.

Like all men of your kind you leave behind a heritage of inspiration. Surely the omnipotent ONE will greet you with "well done thy good and faithful servant."

The Electrochemical Society, Inc.

At the 44th Annual Meeting of the Society the following officers were elected:

President, William R. Veazey of Midland, Mich.; Vice-President, James A. Lee of New York City; Treasurer, W. W. Winship of New York City; Secretary, Colin G. Fink of New York City.

Dr. Veazey is well known in electrochemical and engineering circles for his valuable contributions as Director of the Research Laboratories of the Dow Chemical Company (1927 to date). His main interest lies in the development of magnesium and sodium metals.

Dr. Veazey is a Virginian by birth and received his undergraduate training at Westminster College, New Wilmington, Pa. He then attended Johns Hopkins University where he obtained his Ph.D. in 1907. In that year too he accepted the invitation of Case School of Applied Science to join the Faculty of Chemical Engineering. Here he was active in research besides teaching and was promoted to the head of the Chemical Engineering Department in 1924 and continued in this office until 1936.

Dr. Veazey's scientific and technical publications cover a wide diversity of topics such as negative viscosity, teaching chemical engineering, and insecticides. A dozen or more patents pertain to magnesium alloys.

Iridite

Rheem Research Products, Inc. announce the removal of their general offices to Stan-

dard Oil Building, St. Paul and Franklin Streets, Baltimore 2, Md., LExington 4325.

The manufacturing, electro-plating, and pilot plant operations remain at 2523 Pennsylvania Avenue, Baltimore 17, Md., LAfayette 2300.

Wanted
Chemist and Plater

A large production plating shop located in Michigan has opening for a foreman plater and a solution control chemist. Excellent post-war possibilities. Please state age, experience and salary expected. All replies confidential. Address Box MR-X6, MONTHLY REVIEW, American Electroplaters' Society, 545 Fifth Avenue, New York 17, New York.

Electro-Plating Man

Man with good personality, inclined towards sales who has had experience in metal shaping, forming or finishing field, preferably with heavy experience in electroplating. For problem work with service representatives of manufacturer of materials having wide use in entire industrial field. Excellent post-war future. Location New York City, some traveling. Give details, age, experience, salary desired. If qualifications are of interest, interview will be arranged at our expense. Box 567 Church St. Annex, New York P.O.

Technical Service Representatives

Splendid opportunities for several men under 45 years of age with industrial sales or service experience, preferably with good knowledge of machinery and manufacturing operations. Territories in various states so must be able to re-locate. Car essential. Trained in New York at our expense to qualify in proper use and servicing of our materials which are nationally known and are essential in processing, maintenance and cleaning operations in all industries. Excellent post-war business. Salary to start, commission arrangement later if it would benefit man. Give full details, age, experience, etc. If experience indicates qualification for work, interview will be arranged at our expense. Box A.E.P. No. 3.

Metal Finishing Supervisor

Man capable of assuming complete responsibility of metal finishing for leading metal etching house. Must be thoroughly versed in all plated and chemical dipped finishes, also lacquering and spray and roller coating methods. Experience in the etching of metals desirable however, not essential. Write in full to MONTHLY REVIEW Box MRB 6.

Wanted

Foreman of Electroplating Department. Must also have polishing and buffing experience. Factory located in Hartford, Connecticut area. Long time manufacturer of small electrical parts. Post-war opportunities are excellent. Please give full details as to experience and salary expected. Box MR-Z.

Degreasing Sales Executive

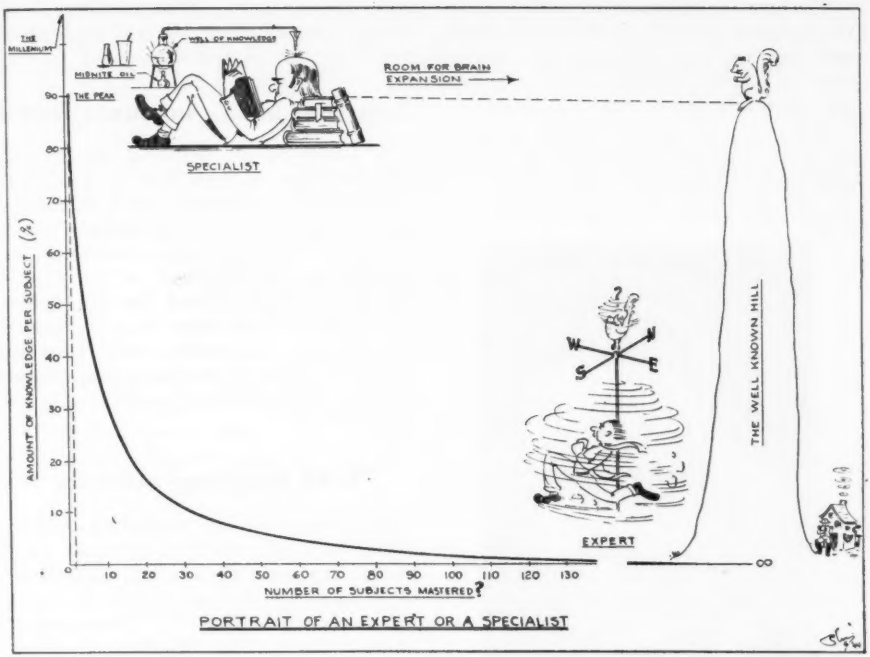
Degreasing sales executive wanted to expand solvent markets for substantial industrial chemical manufacturer. All our personnel know of this ad. Please submit experience, qualifications, and salary expectations to Box MR 6Z, MONTHLY REVIEW.

Wanted

Metal Finishing Supervisor, man capable of assuming complete responsibility of metal finishing for leading metal etching house. Must be thoroughly versed in all plated and chemical dipped finishes, also lacquering by spray and roller coating methods. Experience in the etching of metals desirable however, not essential. Write full to Box MR-B6, MONTHLY REVIEW, American Electroplaters' Society, 545 Fifth Avenue, New York 17, New York.

Witch Oil

The Mitchell-Bradford Laboratories of Bridgeport, Conn. have produced a new rust inhibiting oil, WITCH OIL, which protects metal stampings after pressing and while in storage or transit and acts as a bond for paint or enamel. It is in use



Reprinted by Courtesy of United Chromium

on automobile filters. Shells are degreased after pressing then dipped in WITCH OIL and shipped to point of assembly where complete unit is enamelled without further preparation.

WITCH OIL withstands the baking heat up to 250° and continues to maintain a film on the interior of the shell making unnecessary the application of oil for protection between manufacture and use. WITCH OIL may be used for all types of steel stampings, forgings and castings in the same way.

Promat Appoints W. D. MacDermid Chemical Co.

Mr. J. S. Hicok, Sales Manager, Promat Division, Poor & Company, Waukegan, Ill., announces the appointment of the W. D. MacDermid Chemical Company of Bristol, Conn., as exclusive New England distributor for all equipment and processes of their manufacture. The Promat organization offer the metal finishing industry a number of high speed electroplating solutions based on the superimposition of AC or DC and in the short space of time these procedures have been commercially available, wide spread acceptance has been obtained.

It is felt by the Promat management that the appointment of the W. D. MacDermid Chemical Company, will put their material in the hands of an organization whose personnel has an excellent and intimate knowledge of the metal finishing industry, particularly in the New England area.

New Iridite Finish Protects Galvanizing from Corrosion

Greater resistance to white corrosion for galvanized products is now made possible through the special development of *Iridite Galvon* by Rheem Research Products, Inc., Baltimore.

Like its predecessor, Iridite Olive Drab for zinc and cadmium-plated parts, Iridite Galvon is applied by simple dipping at normal room temperatures. No special equipment or personnel are needed; no electric current is used in the process. The basic coating is susceptible to various dye colors.

Accelerated corrosion tests conducted by the company under U. S. Bureau of Standards Salt Spray Specifications indicated no signs of white corrosion products on hot dip galvanized panels after 236 hours.

Iridite Galvon can be applied either to complete assemblies, parts, or to galvanized sheet previous to fabrication.

Ross To Udylite

The Udylite Corporation, 1651 E. Grand Blvd., Detroit, Mich., announces the appointment of W. H. (Bill) Ross as District Manager of Michigan and Northern Ohio territory.

Bill Ross is well known throughout this area having covered it for several years as sales engineer for Udylite.

Before joining the Udylite organization he was employed by United Chromium Corporation, and by Commonwealth Industries where he gained a thorough, first-hand knowledge of plating and heat treating as sales engineer. He is a graduate of the University of Cincinnati.

Sam Tour & Co. Announce Folder

A 4-page folder, outlining the services and facilities of Sam Tour & Co., Inc., metallurgists, engineers and consultants, has just been issued. It contains views of the several laboratories housed in the company's own buildings at 44 Trinity Place, New York 6, and lists the nature of assignments undertaken in metallurgical and chemical engineering, metal finishing, corrosion, physical metallurgy and consultations. Copies will be sent free on request.

Tube Polishing Machine

Five times greater production without the spiral effect which is prevalent when tubing is polished by hand, is claimed for the Presto Semi-Automatic Tube Polishing Machine introduced by The Manderscheid Company, 605 West Washington Street, Chicago 6, Illinois.

Presto Tube Polishing Machines are completely portable and adjustable for use with any polishing lathe. The polishing machine is merely pushed up to the wheel, adjusted for height and to fit the tube. Total setting up time is less than five minutes according to the manufacturer. Tapered rubber rollers on the polishing machine hold the tube against the polishing wheel with uniform pressure. As the tube rotates, it automatically feeds slowly across the polishing wheel at a uniform rate, providing an evenly polished tube. The rate of feed is easily and accurately adjustable to suit the job. A foot pedal advances the rollers to provide desired polishing pressure.

The machine is adjustable for polishing tubing from 1 to 5 inches in diameter and in any length. Literature on request.

BACK THE MIGHTY 7TH

To those who wonder why we need still bigger War Loans

IN THE 7th War Loan, you're being asked to lend 7 billion dollars—4 billion in E Bonds alone.

That's the biggest quota for individuals to date.

Maybe you've wondered why, when we've apparently got the Nazis pretty well cleaned up, Uncle Sam asks you to lend more money than ever before.

If you have, here are some of the answers:

This war isn't getting any cheaper

No matter what happens to Germany—or when—the cost of the war won't decrease this year.

We're building up a whole new air force of jet-propelled planes and bigger bombers.

We're now building—even with announced reductions—enough new ships to make a fair-sized navy.

At the time this is written, our casualties are nearing the million mark in dead, missing, and wounded. Wounded men are arriving in this country at the rate of over 30,000 a month. The cost of caring for these men is mounting daily.

No—this war isn't getting any cheaper. And won't for some time.

This year—2 instead of 3

We need as much War Bond money this year as we did last. But there will be only 2 War Loans this year—instead of the 3 we had in 1944.

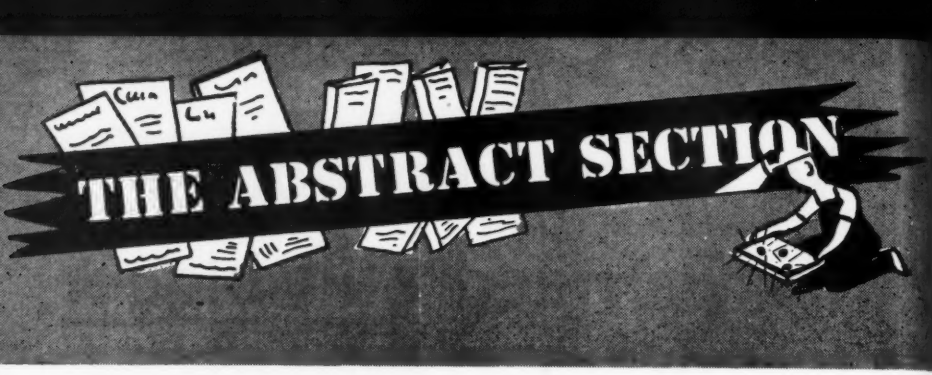
Each of us, therefore, must lend as much in two chunks this year as we did last year in three. That's another reason why your quota in the 7th is bigger than before.

The 7th War Loan is a challenge to every American. The goal for individuals is the highest for any war loan to date. The same goes for the E Bond goal. Find your personal quota—and make it!

ALL OUT FOR THE MIGHTY 7th WAR LOAN

The MONTHLY REVIEW

This is an official U.S. Treasury advertisement—prepared under the auspices of Treasury Department and War Advertising Council



WALTER PINNER

Chairman, Program and Educational Committee

Electrochemical Removal of Broken Tools

J. L. BLEIWEIS and A. J. FUSCO. *Metals & Alloys* **18**, 1075-80 (1943).

Broken steel tools and studs can be removed from Al alloy castings by an electrolytic process. The part is made the anode in a satd. water soln. of $(NH_4)_2SO_4$ and a potential of about 24 v. applied until the current ceases to flow. Details of the construction and operation of the apparatus are given. The Al part is not damaged and the finish and tolerance of the hole are unchanged. A brief description of a chemical immersion method for other materials and for other than steel inserts is also given.

J. W. PERRY, *Chemical Abstracts*

Prevention of Corrosion of Zn and its Alloys with Bright Metallic Surface

By H. D. v. SCHWEINITZ and G. WASSERMANN. *Metallwirtschaft* **21**, 750-4 (1942).

The MBV treatment as used for Al produced also on Zn alloys films which made the surface much more corrosion-resistant than the untreated surface. Solns. of H_2S and other sulfides made Zn surfaces a little more resistant. The best treatment was with diluted solutions of Na silicate; this gave a considerable improvement in the protection from seawater, atmospheric influences and organic acids, especially in Al containing Zn alloys.

M. HARTENHEIM, *Chemical Abstracts*

Anodizing Al and Duraluminum with Subsequent Dyeing

By N. K. GRIGOR'EVA. *Korroziya i Bor'ba s Nei* **6**, No. 5-6, 53-6 (1940); *Khim. Referat. Zhur.* **4**, No. 7-8, 136 (1941).

High-grade Al was anodized in 3% CrO_3 soln. at 50°C. for 1 hr.; and low-grade Al and duralumin in a mixture of 1 part of 2% oxalic acid soln. and 2 of 1% CrO_3 soln. for 1 hr. at room temp., with cooling of the soln. if necessary. The anodized surfaces are readily dyed (Anil-black RV, FF, E Extra) in boiling water solns. of the dyes (2-3 g./100 cc. H_2O) for at least 1 hr. Tests in a moist chamber at 50°C. indicated high stability of anodized and dyed samples. Penetration, bending and abrasion tests gave satisfactory results.

W. R. HENN, *Chemical Abstracts*

Protective-Decorative Finish of Al Surfaces

By G. A. ZUBOVA and N. T. KUDRYAVTSEV. *Korroziya i Bor'ba s Nei* **6**, No. 5-6, 45-52 (1940); *Khim. Referat. Zhur.* **4**, No. 7-8, 135 (1941).

The object of the experiments was to check and improve the existing methods and conditions for surface treatment of Al to determine the most effective methods resulting in highly corrosion-resistant and decorative qualities of Al. Best results were obtained upon anodizing Al in 20% H_2SO_4 soln. fro 30 min. at 20°C. with a cell voltage of 15 v. The films are colorless and form a good mordant for dyes. Best dyeing

results were obtained by treatment for 15 min. in 0.5% solns. of org. dyes at 100°C. Corrosion tests showed high stability. Prolonged contact of the dyed films with water resulted in the washing away of the color. Al samples colored after anodizing in H_2SO_4 soln. faded less readily than did samples otherwise anodized.

W. R. HENN, *Chemical Abstracts*

Removing Cu from Steel

By I. V. MYAKHLOV and Z. N. TIN'YANOV. *Korroziya i Bor'ba s Nei* **7**, No. 1, 52 (1941; *Khim. Referat. Zhur.* **4**, No. 7-8, 134 (1941).

Cu coatings can be removed from steel by a soln. containing CrO_3 300 and $(NH_4)_2SO_4$ 100 g./l. In tests in an atmosphere containing water vapor the samples from which Cu had been removed were more stable than was polished steel.

W. R. HENN, *Chemical Abstracts*

Standardization of the Thickness of Cd and Zn Films

By G. G. TRESPE. *Korroziya i Bor'ba s Nei* **6**, No. 5-6, 57-61 (1940); *Khim. Referat. Zhur.* **4**, No. 7-8, 135 (1941).

A review on the protective properties of Cd and Zn films against climate, humidity, contamination of the air by various gases, etc. Tables give (1) normal electrode potentials and potentials obtained in 3% NaCl soln. of Zn, Cd and Fe, equivalent thickness of films of various metals according to their protective power, (3) relative stability of Zn-Cd films and (4) life of Zn films. Graphs of the corrosion resistance of Zn and Cd under various climatic conditions are given.

W. R. HENN, *Chemical Abstracts*

Zinc-plating

By W. ECKARDT. *Korrosion u. Metallschutz* **17**, 401-3 (1941); *Sheet Metal Ind.* **17**, 109-10, 114 (1943).

The purpose of the research was to discover a method for depositing bright Zn. A large number of American baths were investigated. The best two were: (1) ZnO 50, NaOH 30, NaCN 100, MoO_3 4 and vanillin 0.75 g./l. with a trace of Fe; and (2) ZnO 50, NaOH 30, NaCN 100 and Na acetate 4 g./l. with about 1 g./l. Ni (NO_3). $6H_2O$ and with or without other additions such as 4 g./l. Na perborate, or 2 g./l. oxalic acid and 2 g./l. MoO_3.

IVER ICELSRUD, *Chemical Abstracts*

Corrosion Characteristics of Mg

By G. C. CLOSE. *Light Metal Age* **1**, No. 3, 6-7, 26, 30 (1943).

MgO tends to shrink as it forms and does not form a continuous surface coating; this explains the rapid degeneration of Mg exposed to unfavorable atmospheric conditions. The general chemical resistance of Mg to specific elements, compounds and materials is reviewed. Variations in corrosion-resistance of Mg are attributed more to physical than to chemical conditions. $ZnCrO_4$ primer has been effective in some cases and unsuccessful in others. $ZnCrO_4$ primer is not entirely impervious to watter, and as some water seeps into the primer it unites with the chromates in an oxidizing reaction that tends to passivate the basis Mg. When acidic conditions predominate the chromate ion depolarizes the Mg and decreases its resistance to attack. The primer adheres well when applied as a finish coat by itself, or when applied under air-dried organic surface coatings. Heat, however, seems to affect the bonding power and the composition of the primer. $ZnCrO_4$, when applied under baked organic finishes, becomes brittle during the baking process and flakes and peels when the specimen is flexed. Metallizing tests with Al showed definitely retarded corrosion, but not to an extent of practical value. Anodic coatings were not sufficiently effective. Baked finishes offer more protection to Mg alloys than air-dried coatings. Dowmetal with a baked urea-formaldehyde coating was not attacked in the salt-spray cabinet in 140 consecutive days.

LEOPOLD SCHEFLAN, *Chemical Abstracts*

Prevention of Corrosion of Zn and Its Alloys

By K. VOSS. *Metallwirtschaft* **21**, 754-6 (1942).

Production of protective coatings on Zn and Zn alloys is described. Chromate containing solns. for dipping processes produce the most effective coatings. Of electrolytic methods, that with chromate containing electrolyte with suitable additions is superior to all others as regards corrosion resistance, wear and ability to take colors.

M. HARTENHEIM, *Chemical Abstracts*

BOOK REVIEWS

DR. GEORGE DUBPERNELL

Protective and Decorative Coatings

Joseph J. Mattiello, editor. 349 pages. Published by the Superintendent of Documents, Government Printing Office, Washington, D. C., for the Office of the Quartermaster General, March, 1945. Price, $1.25.

This book has the same title as the five or six-volume work edited by Dr. Mattiello, but there is no connection. It contains a compilation of lectures given to military and civilian personnel of the Army, Navy, W.P.B.. Bureau of Standards, and other Government agencies, under the sponsorship of the Office of the Quartermaster General. The purpose was to present the latest developments in organic coatings. "No specific formulations for various coatings were given; only fundamentals in technology were stressed."

The contents of this book can best be indicated by descriptions of the individual chapters. It contains a very great deal of up-to-date and worthwhile information.

1. Introduction, by H. A. Gardner of the National Paint, Varnish and Lacquer Association, Inc., pages 1-5.
2. Drying Oils, by J. S. Long of Devoe and Reynolds Co., Inc., pages 6-15.
3. Naval Stores As Raw Materials For The Paint Industry, by J.L. Boyer of Newport Industries, Inc., pages 16-29. (With discussion)

4A. New Derivatives Of Naval Stores — Rosin Derivatives In The War, by F. G. Oswald of the Hercules Powder Co., pages 30-41.

4B. New Derivatives of Naval Stores — Derivatives of Rosin and Other Resins, by J. M. Schantz of the Hercules Powder Co., pages 42-56. (With discussion)

5. Varnishes From Less Strategic Raw Materials, by C. T. O'Connor of Durez Plastics and Chemicals, Inc., pages 57-76.
6. Phenolic Resin Coatings, by W. R. Catlow, Jr., of the Bakelite Corp., pages 77-89.
7. Alkyd Resins In War Finishes, by F. W. Whitescarver, of American Cyanamid and Chemical Corp., pages 90-94.
8. Urea-Formaldehyde and Melamine-Formaldehyde Resin Coatings, by W. F. Whitescarver of American Syanamid and Chemical Corp., pages 95-101. (With discussion)
9. Vinyl Resin Coatings, by C. W. Patton of Bakelite Corp., pages 102-132. (With discussion). This is an unusually good article, and is also one of the best illustrated, having 30 photographs.
10. Ethylcellulose Coatings, by J. L. Sherk and A. E. Young of the Dow Chemical Co., pages 133-145.
11. Lacquer-Type Fabric Coatings For Military Use, by D. McBurney, E. I. du Pont de Nemours & Co., Inc., pages 146-152.

12.A. Lacquers — What They Are And Their Principal Uses In War Production, by H. E. Eastlack, E. I. du

Pont de Nemours & Co., Inc., pages 153-160.

12B. Aircraft Lacquers And Dopes, by C. W. Johnson of E. I. du Pont de Nemours & Co., pages 161-163.

13. Metallic Soap Driers, by A. Minick of Nuodex Products Co., Inc., pages 164-167.

14A. Petroleum Solvents and Thinners, by E. M. Toby, Jr., of American Mineral Spirits Co., pages 168-179.

14B. Coal Tar Resins And Solvents, by J. G. Hatman, of Neville Co., pages 180-190. (With discussion)

15. Rutile Titanium Dioxide In Specification Paints, by D. H. Dawson and R. E. Troutman of E. I. du Pont de Nemours & Co., Inc., pages 191-205.

16. Precipitated Iron Oxide Pigments, by K. E. Burgess of Columbian Carbon Co., pages 206-217.

17A. Color, by D. B. Judd of the National Bureau of Standards, pages 218-240. (With discussion)

17B. Color And Its Applications, by G. L. Erikson of The Braden Sutphin Ink Company, pages 214-257. (With discussion). This paper includes two color plates and together with the very excellent one which precedes it, is more than worth the modest price of the book, if one is interested in the subject of color in general and its applications in the protective coating field.

18. Behavior of House Paints on Different Woods, by F. L. Browne of the Forest Products Laboratory, U.S. Dept. of Agriculture, pages 258-284.

19. Luminescent Materials and Coatings, by G. F. A. Stutz of the New Jersey Zinc Co., pages 285-299.

20. Visual And Infrared Photographic And Spectrophotometric Study Of Pigmented Coatings, by V. C. Vesce of Harmon Color Works, Inc., pages 300-338. This is an unusually well illustrated paper with 44 figures.

This book includes a good subject index (pages 339-349). It is well bound and well illustrated, and the papers seems uniformly good, with some more detailed and extensive than others, as indicated by the number of pages and the above comments. Seven of the 24 papers have biliographies appended. The book as a whole is similar in many ways to our last A.E.S. Annual Conference Report. In view of its low price, it should be purchased by everyone interested in the papers it contains.

A.E.S. BOOK DEPARTMENT

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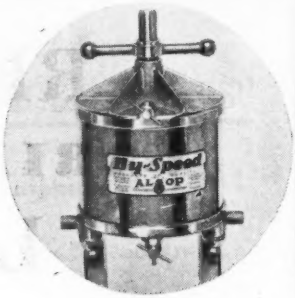
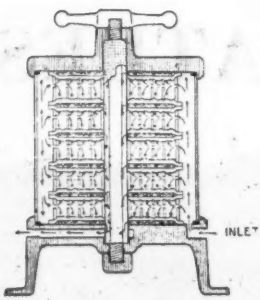


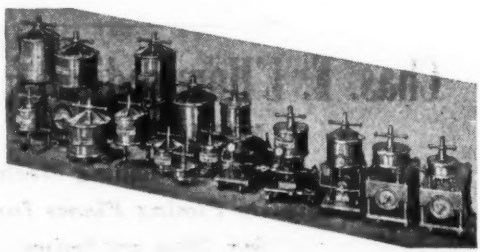


Dirt in the bath is the nemesis of the plater. And the ALSOP Sealed-Disc FILTER is the nemesis of dirt, any kind of dirt or oil impurities that can get into or develop in a plating bath.

The principle of ALSOP Sealed-Disc FILTRATION involves a series of fiber discs, each graded from loose-packed to close packed. The loose-packed side faces outward to catch the coarsest particles. Each cell presents two large surfaces of filter area, thus providing exceptionally high capacity for a given volume. Changing of discs is simple and involves no loss of solution.

So many of the ALSOP Sealed-Disc FILTERS are now in service in plating shops that the type can be considered as standard practice. It has earned the reputation for sure, fast, clean filtration of plating baths.

ALSOP for "Hy-Speed" FILTRATION and MIXING



ALSOP *Engineering Corp.*

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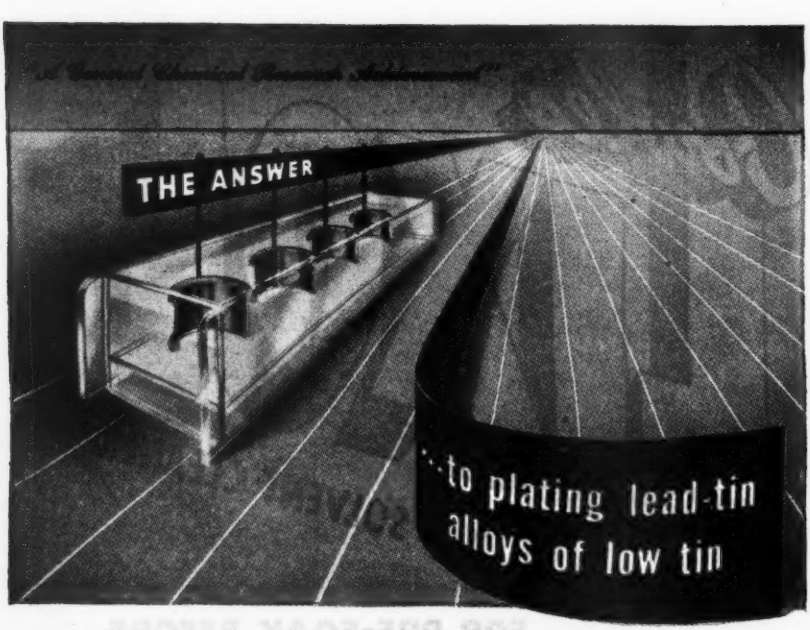

For more than 25 years metal finishers have sought a successful means of plating lead-tin alloys in the low tin ranges. "Not feasible . . . inoperable . . . too many variables," read published reports on method after method.

Now—with the new chemical tools of General Chemical Fluorine Research—platers are achieving the "impossible."

Here's how: General Chemical *Lead* and *Tin Fluoborate solutions* are thoroughly compatible. Combined in baths using dual or alloy anodes, they plate dense, fine-grained lead-tin alloy deposits uniformly, simultaneously, and *with the tin easily controlled at low ranges!*

Thus, *in one operation* an alloy coating is produced that is harder, more wear-resistant, and has a more attractive appearance than lead plate alone. Little wonder that leaders in the bearing industry are adopting the combination fluoborate bath for lead-tin alloy plating of their products!

"First in Fluorides" For working samples of General Chemical's Lead, Tin, or other fluoborate solutions—for sound, practical information on their applications, based on the research and "know how" of America's foremost producer of fluorine compounds—contact the nearest General Chemical Sales and Technical Service Office or write General Chemical Fluorine Division, 40 Rector Street, New York 6, N. Y.

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THE FUNDAMENTALS OF CHEMISTRY FOR ELECTROPLATERS

PART XX

THE STRUCTURE OF ATOMS

Samuel Glasstone, D. Sc. Ph. D.

The Atom Not Indestructible

IN an earlier article (Part III, MONTHLY REVIEW, January, 1944) reference was made to the universally accepted idea that all matter is made up of atoms, the atom being the smallest conceivable particle of an element which still retains the property of that element. At one time it was believed that the atom was indestructible, and could not be broken down into anything simpler. It is now known, however, that by special methods, such as by the use of very intense electric fields or by means of highly accelerated particles acting as missiles, it is possible to disintegrate atoms into still smaller units. The products, however, do not always possess the properties of ordinary atoms, and it is their nature and their relationship to atoms of matter which will be considered here. Information concerning the units of which atoms are built up has been obtained from various, apparently independent, sources, and a consideration of the manner in which these units combine to yield the atoms of various elements is of great interest and importance to chemistry. For this reason a brief outline will be given in the present article of the development of the views held at the present time in connection with the structure of atoms. Of course, it must be clearly understood that the atom is far too small to be seen, even in the most powerful microscopes at present available, and consequently it is impossible to obtain direct information concerning atomic structure by any method of direct observation. However, as a result of a variety of indirect information, it has been possible to devise a theory concerning the structure of atoms which provides a satisfactory interpretation of their known properties.

The Electron and the Atom

Some of the earliest observations having a bearing on the problem of atomic structure were made in the latter part of the nineteenth century in connection with studies of the passage of electricity through tubes containing gases at low pressure, the so-called "discharge tubes." It was seen that certain rays, known as "cathode rays" were sent out from the negative electrode or cathode. These rays differed from ordinary light rays, because they could be deflected, that is, bent out of their normal straight line path, by the application of an electric or magnetic field. From a study of the properties of the cathode rays it was concluded that they consist of very small particles, much smaller than an atom, and carrying a negative electrical charge. There are many good reasons for believing that the charge carried by each of these particles is the unit (or atom) of electricity. The particles constituting the cathode rays are now called "electrons," and experiments on electrons have shown that they are ex-

tremely light in weight, for it takes something like 1840 electrons to weigh as much as an atom of hydrogen, the lightest known atom of any element.

After the discovery of the electrons in the cathode rays of gas-discharge tubes, it was found that these negatively charged particles could be obtained in other ways, for example, by the exposure of certain materials to light (photoelectric effect) or by heating suitable substances (thermionic effect). It may be mentioned, in passing, that these two methods for producing electrons have found important practical applications in connection with photo-electric cells and with radio tubes, respectively. In studying the electrons obtained in different ways, the remarkable result was found that no matter how they were produced and irrespective of the nature of the materials employed for their production, the electrons always possessed the same essential properties; they always had the same electrical charge, both in sign and magnitude, and the same mass. The inevitable conclusion to be drawn, therefore, is that the electron represents a fundamental unit of the structure of all kinds of matter. In other words, just as all substances are ultimately composed of atoms, so the atoms themselves must consist, at least *partly*, of electrons.

Since electrons carry negative electrical charges, it is obvious that they cannot be the sole constituent of atoms, for matter as we know it usually carries no net electric charge; that is to say, matter is ordinarily electrically neutral. This means there must be a compensating positive charge on an atom so as to neutralize the negative charges of the electrons. The existence of positively charged particles was also detected in discharge tubes under suitable conditions, but the masses and charges of these particles were found to vary according to circumstances. It appeared, therefore, that there was not a simple positive particle, acting as a unit of atomic structure, similar to the electron. As a result of these observations the view developed that the atom consisted of something like a sphere of positive electricity in which was embedded a large number of electrons, the negative charge on the latter just compensating for the positive charge of the rest of the atom.

The Alpha-Particle

While the foregoing ideas were being developed, other discoveries were being made which necessitated important changes in them, and which led to the development of the modern ideas concerning the structure of atoms. In 1895, H. Becquerel discovered the phenomenon now known as "radioactivity," namely, that certain substances are able spontaneously to send out active radiations. Three different types of radiation were identified, of which two only need be mentioned. One of these, the beta-rays, were observed to be identical with electrons, so that another source of these particles was discovered. The second type of radiation, the alpha-rays, was found to be made up of positively charged particles of definite mass. Later the alpha-particles were shown to be identical with atoms of the element helium that had become positively charged. Their mass was thus about four times that of the hydrogen atom, and more than seven thousand times that of an electron. These, relatively heavy, alpha-particles obtained from a radio-active material have the power of penetrating matter. When they do so, the great majority of the particles are observed to pass straight on, with little deviation from their original path, but a small proportion undergo a very marked deflection so that they are completely turned off with their course.

The Nuclear Atom

The importance of this observation in connection with atomic structure was realized by E. Rutherford in 1911. He showed that the facts could be accounted for in an exact manner by supposing all atoms to consist of a small central core or nucleus, which contained all of the mass and the whole of the positive charge of the atom. The negatively charged electrons, which were required to neutralize the positive charge of the nucleus, were then regarded as being arranged around the nucleus at a relatively large distance from it, so that the atom has a somewhat "empty" structure. It must be remembered, of course, that the term "large" is used here in a relative sense, for the diameter of an atom is only about ten billionths of an inch, but the diameter of the nucleus is probably no more than about one hundred-thousandth part of this. In spite of its

small size, the nuclear atom as described by Rutherford, has been compared to the solar system: the positively charged nucleus, carrying the mass, has been compared to the sun, and the surrounding electrons to the planets.

When an alpha-particle from a radioactive source passes through matter it must pass through the atoms of which the matter is composed. Since most of the space is "empty," the particles proceed on their path without being affected. If one should encounter an electron, as is very probable, the latter being so much lighter will be pushed out of the way, and the effect on the alpha-particle will not be noticeable. However, on the rare occasion when a positively charged, relatively heavy, alpha-particle happens to come close to the nucleus of an atom, the positive charge and condensed mass of the latter will cause the alpha-particle to be violently repelled, so that it will be completely deflected from its course. Thus it is possible to explain why the great number of alpha-particles pass through matter undeflected, but a small number are turned completely from their course. The situation might be compared to a comet moving through the solar system: in the majority of cases the comet would pass clear through space, but if it should happen to come near the sun, it would certainly be deflected from its path.

The basic idea of the nuclear atom described above is still accepted at the present time. There remain, however, two matters to be considered. First, there is the question of the number of electrons surrounding the nucleus of any particular atom, and second, the problem of the structure of the nucleus itself. On both of these subjects important information is available, and this will be described in the next article.

HARD CHROMIUM PLATING

(*Continued from page* 594)

experience and I am glad to have had this opportunity of repaying some of the debt. I do hope this spirit continues to exist in peace time.

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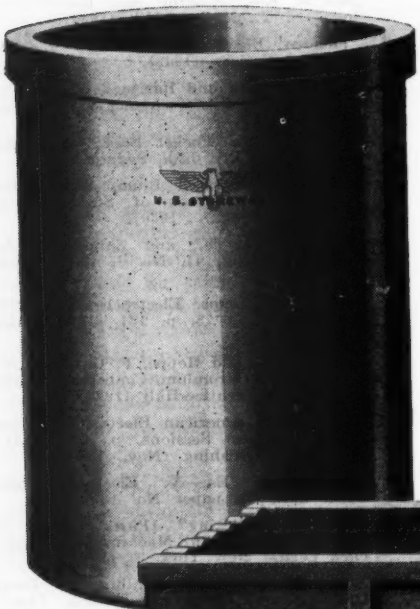

Fig. 87

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Fig. 92

Fig. 87 Cylindrical Pots (without handles) with or without outlets and covers, in capacities from 15 to 500 gallons.

Fig. 92 Rectangular Tanks, in capacities from 4 to 320 gallons.

Fig. 88 Cylindrical Pots (with handles) with or without outlets and covers, in capacities from 5 to 30 gallons.

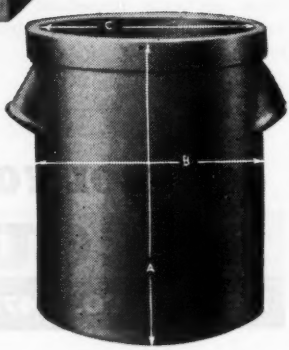

Fig. 88

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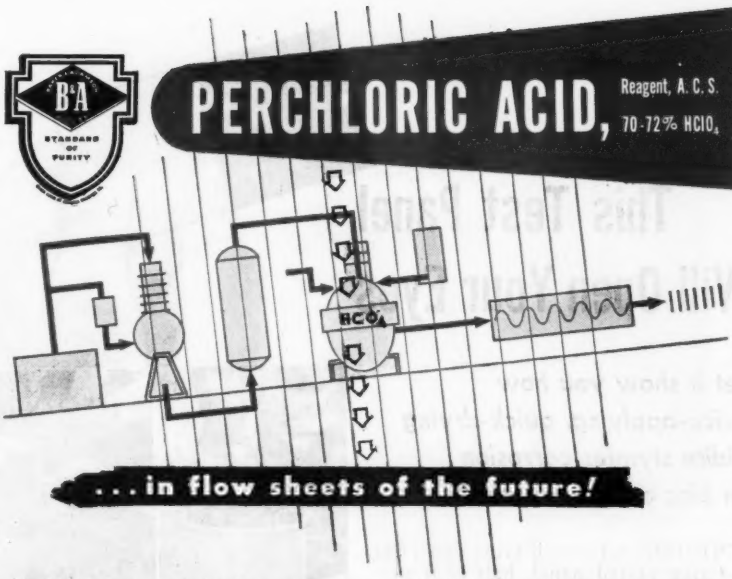

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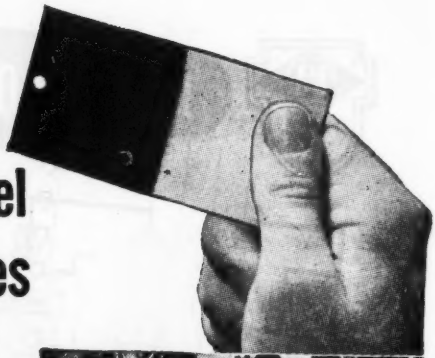

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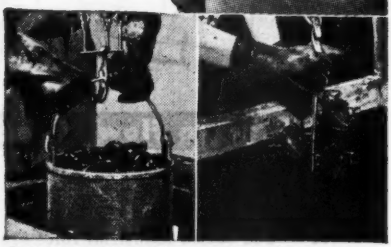

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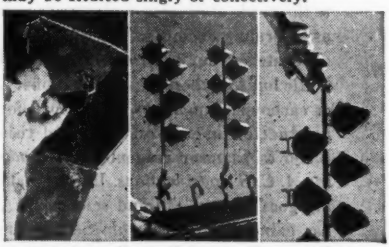

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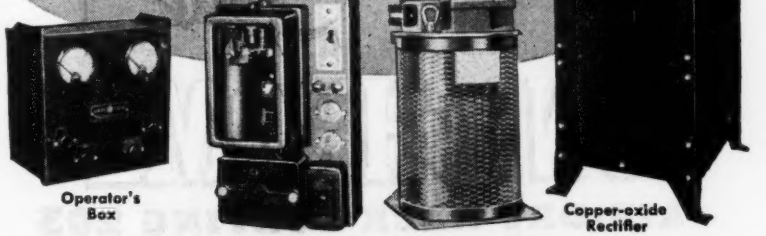

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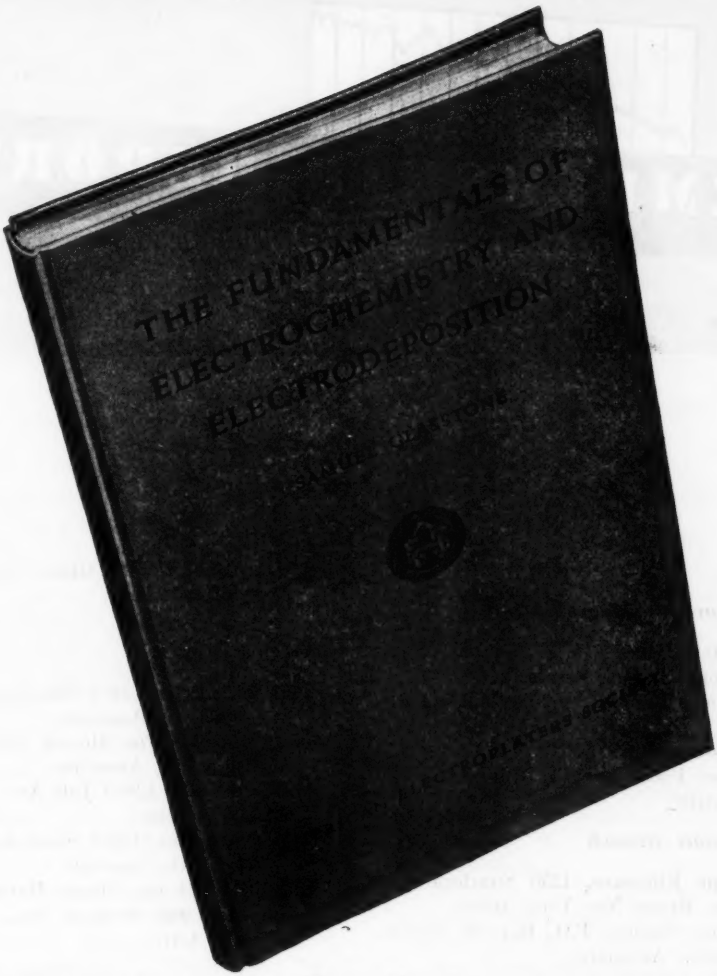

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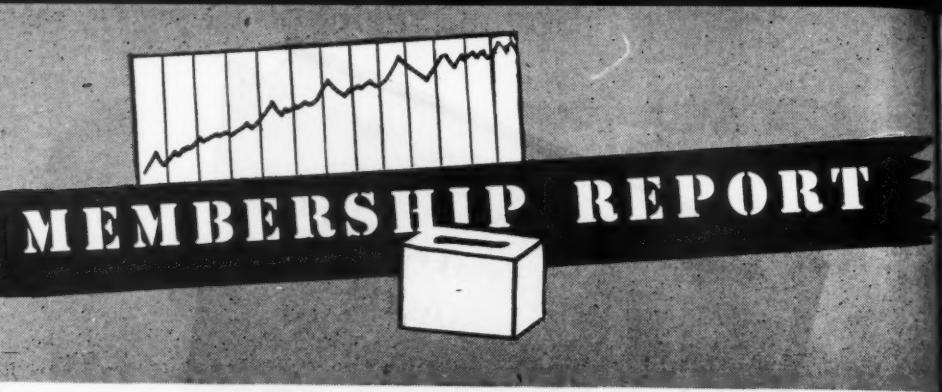

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Robert Lamb, 1133 E. 152 St., Cleveland 10, O., Associate

Clarence Jordan, 3436 West 10th St., Erie, Pa., Active

Hartford Branch

Samuel Merman, Clairglow Mfg Co., Portland, Conn., Associate

Otto Schaefer, The Napier Co., Meriden, Conn., Associate

Milwaukee Branch

Langley Ward, 305-07 Hamilton St., Racine, Wis., Associate

Sylvester Boruchi, 279 East Gauer Circle, Milwaukee, Wis., Active

Raymond Grace, 1721 S. 81 St., Milwaukee, Wis., Associate

Fred Anderson, 408 S. 75 St., Milwaukee, Wis., Active

Newark Branch

William Freeman, 339 Walnut St., Newark, N. J., Active

Joseph Greco, 10 S. Pine Lane, Newark, N. J., Associate

Irving Gemmell, Ravine Dr., Matawan, N. J., Associate

Providence-Attleboro Branch

Ernest Whitwam, 60 Maple St., Thornton, R. I., Active

Cecil Bailey, Box 248, Chartley, Mass., Active

Raymond Jette, 54 Union St., Attleboro, Mass., Active

CHANGE OF STATUS

Detroit Branch

J. D. Wieland from Associate membership to Active membership

TRANSFERS

H. L. Benner from Buffalo Branch to Detroit Branch

H. O. Anderson from Chicago Branch to Twin City Branch

W. Safranek from Chicago Branch to Columbus Branch

S. G. Englund from Chicago Branch to Rockford Branch

J. W. Eaton from Chicago Branch to Rockford Branch

W. J. Erskine from Chicago Branch to Rockford Branch

J. F. Anderson from Chicago Branch to Rockford Branch

L. Keiser from Chicago Branch to Rockford Branch

W. Mercer from Chicago Branch to Rockford Branch

D. Stockton from Chicago Branch to Rockford Branch

Lawrence Durney from Pittsburgh Branch to Bridgeport Branch

Robert Peterson from Milwaukee Branch to Twin City Branch

E. R. Frost from Milwaukee Branch to Twin City Branch

D. H. MacDonald from Bridgeport Branch to New Haven Branch

RESIGNATIONS

Baltimore-Washington Branch

Henry Bartholomew

Boston Branch

George Brown, Jr.

Buffalo Branch

A. Boy

Montreal Branch

E. A. Lunn

SUSPENSIONS

Baltimore-Washington Branch

John MacDermid

Chicago Branch

P. Woodson

Hartford Branch

Harold Bishko

Frank Duncan

Thomas Finn

Louis Galasso

J. J. Pernal

John Ready

Luke Ruggerio

Montreal Branch

S. Melanson

R. Du Pont

DEATHS

Hartford Branch

L. C. Andrews

Plater Wanted

All around man for job shop. Special experience in hard chrome desirable, permanent. Satisfactory arrangements for right man. Agreeable working conditions. Box MR-6B.

Silver Plater Wanted

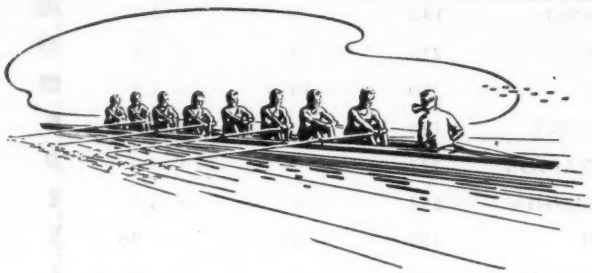
For repair work holloware, etc. Permanent. Satisfactory arrangements for right man. Agreeable working conditions. Location, New York State. Box MR-6C.

MEMBERSHIP CHART

BRANCH	May 1945	Change in Membership	Percent Change
FIRST GROUP			
CLEVELAND	143	+ 5	+ 3.4
NEWARK	213	+ 6	+ 2.8
DETROIT	390	+10½	+ 2.6
BRIDGEPORT	118	+ 2	+ 1.6
GRAND RAPIDS	121	+ 2	+ 1.6
PHILADELPHIA	154	+ 2	+ 1.2
CHICAGO	357	+ 3½	+ .98
INDIANAPOLIS	112	+ 1	+ .89
BALTIMORE-WASH.	123	+ 1	+ .81
WATERBURY	122	+ 1	+ .81
NEW YORK	191	—	—
LOS ANGELES	151	—	—
TORONTO	119	—	—
ST. LOUIS	116	—	—
BOSTON	157	— 1	— .63
HARTFORD	126	— 6	— 4.7
SECOND GROUP			
PROV.-ATTLEBORO	101	+ 3	+ 2.9
DAYTON	109	—	—
MILWAUKEE	107	—	—
ROCHESTER	90	—	—
NEW HAVEN	106	— ½	— .47
PITTSBURGH	80	— ½	— .62
BUFFALO	89	— 1½	— 1.6
THIRD GROUP			
ROCKFORD	23	+ 9½	+41.
TOLEDO	54	+ 3	+ 5.5
SAN FRANCISCO	55	+ 3	+ 5.4
SYRACUSE	57	+ 2	+ 3.5
TWIN CITY	52	+ 1½	+ 2.8
CINCINNATI	57	—	—
JACKSON-LANSING	62	—	—
AUSTRALIA	51	—	—
LANCASTER	39	—	—
MONTREAL	54	— 3	— 5.5

Membership May 1, 1945 = 3972
Membership June 1, 1945 = 4015½

Gain in Membership = 43½
Percent of Gain 1%



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STORTS WELDING COMPANY

42 Stone Street Meriden, Conn.

Manufacturers of Welded Fabrications to Specification

BALTIMORE-WASHINGTON BRANCH

The regular monthly meeting of the Baltimore-Washington Branch of the A.E.S. was held in Washington at the Kenesaw Apts. on May 9th, 1945. This was the last meeting before the summer layoffs. Regular meetings resume in October.

Thirty-eight attended the meeting, thirty-three being present for the dinner.

The meeting was called to order by President Huston, and the guests present were introduced.

Minutes of the April meeting were read and approved.

Progress reports were made by the Branch Research Committee, and the Committee investigating affiliation with the Engineers' Club of Baltimore.

It was moved and passed that the Baltimore-Washington Branch of the A.E.S. take the necessary steps, through their committee, to affiliate with the Engineers' Club of Baltimore.

A list of the members who were delinquent in their payment of dues was read. After a lengthy discussion it was agreed that any matter of suspension should be left to the Secretary-Treasurer acting in accordance with regulations as stated in the By-Laws.

Payment by the Treasurer of accumulated bills was approved.

A report was made by each of the incumbent officers covering their work during the previous business year.

A rising vote of thanks was given the officers of the Branch for the good work accomplished during the 1944-45 year.

On the recommendation of the nominating committee the officers of the past year were returned to office.

The officers for the 1945-46 year as elected are:

President, K. M. Huston; Vice-President, A. Brenner; Librarian, W. Olson; Secretary-Treasurer, A. G. Taylor.

A motion was made and passed that, President Huston be appointed the Baltimore-Washington Branch delegate to the business session of the Supreme Society which meets at Pittsburgh on June 18th of this year.

It was moved and passed that, "The Baltimore-Washington Branch endorse the amendment to the constitution which is being presented by the Newark Branch.

At the end of the business session the meeting was turned over to Librarian Olson who introduced Mr. W. J. Schneider, plating industry of the E. I. du Pont de Nemours Co. Mr. Schnieder gave a talk on "Potassium High Speed Copper Plating."

At the conclusion of the talk, Mr. Schneider was given a rising vote of thanks.

The meeting then adjourned.

ALBERT G. TAYLOR, *Sec'y-Treas.*

WATERBURY BRANCH

New officers were elected at the meeting of the Waterbury Branch held at the Hotel Elton on Friday, May 11, 1945. The nominating committee offered in nomination the following members for officers for the coming year:

President, W. L. Cassell; 1st Vice-President, Bert W. Sage; 2nd Vice-President, F. S. Foster; Educational Chairman, E. W. Couch; Assistant Educational Chairman, W. D. Starr; Secretary and Treasurer, S. L. Henn; Assistant Secretary, A. W. Tracy; Board of Managers: Ralph Colter, C. A. Kilborn, A. J. Maz; Delegate to National Business Meeting, A. J. Maz; Alternate Delegate, C. A. Kilborn.

As no other names were offered in nomination the Secretary was instructed to cast one ballot electing these members as officers.

Inasmuch as the meeting of the National Society this year at Pittsburgh is to be for business only, it was decided that it would be advisable to pay the expenses of our delegate. A motion was made and seconded to pay the expenses of the delegate and it was unanimously carried. In addition to representing our own Branch, Tony Maz will also represent the Twin City Branch by proxy.

The outgoing officers were called upon to make a report of the activities of the Branch during the year which has just closed. Each officer reviewed the program and progress made during the year.

Perry Sloane brought to the attention of the group the recent authorization for the resumption of amusement activities, many of which require travel and the assembly of large groups of people. It was his opinion, that if these amusements were to be permitted, certainly conventions of technical societies should be allowed. This was agreed upon by every one present, however, Ellsworth Candee pointed out that even if we were permitted to hold conventions at this time, it would still be impossible to do so this year because of the enormous amount of preparation needed. After some discussion on the subject, a motion was made, requesting our delegate to see that the National Business Meeting of the Society took action to assure us of the convention for next year. This motion was seconded and unanimously approved.

Ellsworth Candee read the proposed amendments to the constitution offered by the Baltimore-Washington Branch and the Newark Branch concerning the change in classification of membership and the reorganizing of the Research Committee. As usual, it was voted that our delegate go to the convention uninstructed.

At the conclusion of the business meeting, Donald Hilliard assumed the post of technical chairman and conducted the balance of the meeting. Jack Hyner selected for his book review a small English book published by W. Heffer and Sons, Ltd. ("Spot Tests for the Identification of Certain Metallic Coatings and of Certain Metals in Bulk," written by Evans and Higgs). He called to our attention several convenient tests discussed in this book, of considerable value in identifying plated coatings.

Bill Starr in discussing the effect of V-E Day on priorities stated that there would be little likelihood of changes in methods of obtaining chemicals. To obtain equipment, it is now possible to go to your local War Production Board for a priority and the chances are good that a suitable priority will be granted.

Charles A. Marlies of Metaplast Company was the speaker of the evening. He discussed "Electroplating on Plastics." At the present time, this method of treating plastics is particularly important in the fields of electrical conductivity and light reflection. It is valuable in the reduction of weight and also for increasing the heat resistance of plastics. Prior to the war, plating on plastics was used to some extent for color and decorative effects. When the war is over, this use will be increased many times, and will perhaps rank in importance to the present functional uses.

Numerous methods have been developed to obtain metallic coating on non-metallic material. One of the most useful is the deposition of silver. By reducing the metal from a silver solution, intricate parts can be rendered conductive and coatings of various metals can be readily plated. Mr. Marlies gave a very illuminating talk on this subject, detailing its advantages and limitations and methods for obtaining the desired results. At the close of the meeting he was given a rising vote of thanks for his interesting talk.

S. L. Henn, *Secretary*

SYRACUSE BRANCH

The Syracuse Branch met on Friday, May 11, in Bowne Hall, Syracuse University. Twenty-three members were present when Dr. Murphy called the meeting to order at 8:00 P.M.

The reading of the minutes of the April meeting was followed by a review of the correspondence of the previous month, including a letter of announcement from the Rochester Branch on its May meeting and a letter from the Baltimore-Washington Branch sponsoring an amendment

to change Section 6 of Article IV of the By-Laws, Supreme Society.

After discussion of this amendment, a motion was made, seconded and carried that our delegates be instructed to vote for the amendment as sponsored by the Baltimore-Washington Branch.

Mr. D. M. Overcash was then called upon to announce the results of the election of officers for the Syracuse Branch. A tabulation of the mailed-in vote had resulted in the election of the following men to serve as officers for the next fiscal year: President, Dr. N. F. Murphy; First Vice-President, Paul Swartz; Second Vice President, Robert Colvin; Secretary-Treasurer, Neil Maffei; Librarian, Dwight Overcash, and for the Board of Managers, Irving Psyck, William Langanmayer, and Herbert Gerhardt.

Mr. A. H. DuRose, Research Chemist for the Harshaw Chemical Company, was the speaker for the evening. Mr. DuRose discussed Lead-Tin Alloy Plating. The conditions of operation of the plating bath were fully explained and a number of interesting slides illustrating the effects of varying the glue concentration and the ratio of lead to tin as well as the total thickness of plate, on the corrosion resistant properties and appearance of the plate, were shown.

Following an interesting discussion period, the meeting was adjourned by Dr. Murphy.

NEIL MAFFEI, *Sec'y-Treas.*

MILWAUKEE BRANCH

The Milwaukee Branch held its regular meeting May 4th, at the Wisconsin Hotel.

The new officers were installed for the coming year. New members were initiated.

The meeting was then turned over to Mr. T. Hartshorn, our new Librarian who introduced Mr. Lewis of the Northwest Chemical Company who spoke on "Surface Finishing Metals." His talk proved to be very informative. He told of experiments with lamenated deposits of copper and zinc. These deposits upon heating showed alloying between the zinc and copper, suggesting the possibility of better corrosion resistance with lamenated deposits, not only of copper and zinc but other metals.

He told of experiments with nickel that showed up the porosity of electro deposited coatings that were removed from the basis metal. He prophesied that specifications for nickel after the war would demand thicker coatings.

Mr. Hartshorn contributed some interesting information on the immersion deposits of nickel used as the under coating for porcelain enamel.

The meeting adjourned after many questions were answered by Mr. Lewis.

JAMES H. DURNFORD, *Secretary*

HARTFORD BRANCH

The May open dinner meeting was held on Monday evening, May 22nd at the Hotel Garde in Hartford. A veal steak dinner was served in the Green Room to 23 members and guests.

President Harry Sanders called the technical session to order at 8:15. The untimely death of Charles Andrews was announced and members and guests stood in silence for a minute in silent tribute to one who was a true friend to all who knew him.

George Hogaboom presented his monthly feature, "Latest Developments." The meeting was then turned over to Ike Newell, technical chairman for the evening, who introduced the speaker, A. E. Carlson, General Chemical Co. The subject of the talk was "Lead-Tin Alloy Plating from Fluoborate Solutions." Mr. Carlson presented in his paper one of the most complete researches ever made on the subject. It also developed that Mr. Carlson had a great deal of knowledge concerning fluoborate solutions other than the lead-tin alloy system. As a result, Mr. Carlson was held on the floor for a full hour after the conclusion of his talk answering questions of which almost everyone present had at least one. At the conclusion of the discussion a small display of articles palted in the lead-tin alloy fluoborate system was shown, and descriptive literature was passed around. A rising vote of thanks was extended to Mr. Carlson for one of the fienst presentations of the year.

The meeting adjourned at 10:30. Attendance 60.

FRANK SMITH, *Secretary*

LANCASTER BRANCH

The Lancaster Branch of A.E.S. met this evening at 8 o'clock P.M. The meeting was held at Boothman's Bowling Center.

The Secretary read the minutes of the last meeting and they were approved.

There being no further nominations for officers the secretary was instructed to cast a ballot and the following men were elected:

D. Fleming, President; H. Kilheffer, Vice-President; W. Fordney, Secretary-Treasurer; R. L. Hoenstine, C. E. Brubaker, and N. Gebert, Board of Managers.

After some discussion W. H. Fordney was elected delegate to the business meeting of the Society. The Lancaster Branch to pay the expenses.

The business meeting was adjourned at 8:45 after which a movie "Target for Today" was shown. The balance of the evening was spent in bowling and card playing. Refreshments were served during the evening.

WILLIAM H. FORDNEY, *Sec'y-Treas.*

SPRINGFIELD BRANCH

The March meeting of the Springfield Branch, American Electroplaters Society was held at the Hotel Charles, Springfield, Mass. on March 26, 1945. The meeting was called to order at 8:15 P.M. by Pres. Hastie.

Pres. Hastie introduced the speaker of the evening, Mr. J. G. Ritter, Section Engineer, War Products Division of Westinghouse Electric & Manufacturing Co. Mr. Ritter then gave an extremely interesting talk on the "Tank Gun Stabilizer." Much interest was shown by the members in this instrument which has greatly aided the accuracy of the gun fire of American tanks. Mr. Ritter has been in charge of development of the stabilizer ever since its arrival at the East Springfield plant of Westinghouse.

In addition to the talk and the showing of the main parts of the unit there was also a movie of tank gun target practice with the gun under control of the stabilizer. At the end of the meeting there was a general discussion and question period.

Meeting adjourned at 10:00 P.M.

PAUL F. LYMAN, *Sec'y-Treas.*

TWIN CITY BRANCH

The meeting was called to order by President Lindemann at 8:00 P.M., Monday, May 7th at the Hotel Andrews in Minneapolis. Mr. Lindemann called upon Mr. Walter L. Pinner of the Supreme Society who attended our meeting and Mr. Pinner then presented us with our Permanent Charter. Following Mr. Pinner's presentation the Secretary-Treasurer, Robert L. Buckley, gave his report which was followed by the Treasurer's Final Financial Report for the Fiscal Year. There was an announcement made about the branch's First Annual Party which is to be held on Wednesday, June 6th, at the Covered Wagon in Minneapolis. Mr. Lindemann then read a letter from Mr. Ben J. Rosenthal, Chairman of the Auditing Committee, which stated that the Treasurer's books were found to be in order. Following the report of the Auditing Committee, the election of Officers was undertaken. Mr. Paul M. Craig read the report of the Nominating Committee which was as follows:

Paul W. Felt, President; Gordon W. Lillicrop, First Vice-President; A. T. Leonard, Second Vice-President; and Robert L. Buckley for Secretary-Treasurer.

Mr. Lindemann announced that nominations were then open. Mr. Rosenthal made a motion that the slate of officers as stated by the Nominating Committee be approved. This motion was seconded and a rising vote showed that it passed unanimously.

Mr. Paul Felt, our newly-elected President, was installed and he gave a brief talk in which he requested every member to seek new members so that our branch will be able to grow continuously. Following the installation of Mr. Felt the meeting was turned over to Mr. Ralph A. Bowman, our Librarian. Mr. Bowman introduced our speaker, Mr. Louis J. Shustik, of E. I. DuPont, who spoke on "The Hull Cell as a Tool in the Plating Shop." Mr. Schustik's talk was very interesting and informative, and he was given a vote of thanks by all present.

At this meeting there were 47 persons present, the largest attendance at any of our meetings thus far. We were very glad to have four out-of-town persons present.

They were:

Mr. Bert Lewis and Mr. Erwin Wolff of Northwest Chemical Company, Detroit; Mr. David Stockton of Udylite Corporation, Chicago; and Mr. George R. Beach, Jr. of DuPont. These men were in addition to Messrs. Schustik and Pinner.

The meeting was adjourned at 10:15 P.M.

ROBERT L. BUCKLEY, *Sec'y-Treas.*

TOLEDO BRANCH

The annual meeting of the Toledo Branch of the A.E.S. was held in the office of the Victor Miner Co., Toledo, Ohio on April 5th.

The meeting was opened by the President Mr. Allison at 9:00 P.M. with 15 members and two guests present.

Minutes of the previous meeting were approved as read, minutes of the 1944 annual meeting were read and approved.

After some discussion it was decided to conduct a question box at each meeting and Mr. Vannorsdall agreed to get cards printed for the purpose.

Mr. Allison gave a five-minute talk on the increased membership in the Branch.

A letter from the Executive Secretary stating the office of defense transportation denied permission to hold our National Convention this year was read. In a letter from Mr. Dimon, Chairman of the Educational Committee for the 1945 Convention urged all prospective authors to submit their papers as planned, since members will not have the opportunity for personal contact at this time, he deemed it doubly important that a 1945 volume containing these papers be published. All papers should be submitted in triplicate to Mr. Richard Dimon, 210 Semple St., Pittsburgh, Pa. not later than June 1st.

Mr. Pinner, Educational Chairman of the Supreme Society in his letter urged our membership to cooperate with Mr. Dimon in obtaining papers in spite of the unusual existing situations.

A letter from the executive secretary was read in which he announced that there would be a business meeting held June 18th, 1945 to transact the necessary business of the society. Each Branch is to send only one delegate to this meeting, who is to cast the three votes for his Branch, since the attendance must be kept down to 50. Each delegate should come prepared to discuss the advisability of electing new officers or of retaining the present ones due to the unusual times and the limited representation permissible at the meeting.

After some discussion, a motion by Mr. Vannorsdall that under the circumstances, Toledo Branch should not send a delegate to this meeting and that our Branch Proxy should be given to the Detroit Branch. This was seconded by Mr. Weiker and passed. A motion by Mr. Vannorsdall to accept the financial report was seconded by Mr. Miner and passed.

Mr. Wieker, Mr. Vannorsdall, and Mr. Gerity were appointed on the nominating committee and the auditing committee. At this time the business meeting adjourned to be resumed at the conclusion of the educational program, for the purpose of electing new officers.

Mr. Wurster of the Industrial Filters gave a very good talk on trouble shooting in filtering. Mr. Rickert of the same company gave a fine demonstration with one of their filters, whereby the bags are cleaned without being removed from the machine, by an air wash. At the conclusion of their talk both Mr. Wurster and Mr. Rickert answered questions put to them by the members to quite some length.

The chair at this time resumed the business meeting and asked for a report of the auditing committee, who reported the books to be in good order.

The nominating committee reported that they favored the retention of the present officers for another year.

The only nomination from the floor was from Mr. Vannorsdall, who nominated Mr. Gieger for the office of Librarian, this was seconded by Mr. Miner.

The following nominations were duly elected to their respective offices by unanimous votes.

Kimsley Allison, Preident; Victor Miner, First Vice-President; R. G. Phillips, Second Vice-President; Gaston Bergeman, Secretary; Edward St. Arnaud, Treasurer; Maynard L. Geiger, Librarian; Walter Weiker, James Gerity, and Charles Vannorsdall, Board of Managers.

Meeting adjourned at 10:30 P.M.

GASTON BERGEMAN, *Secretary*

TORONTO BRANCH

The April meeting of Toronto Branch was held in the Royal York Hotel on the evening of Friday, April 14th.

The 45 members present were called to order by President Allan Byers at 8:15.

The meeting was privileged to hear a talk by Mr. C. E. Bourne, Manager, Special Products Section, Apparatus Department, Canadian General Electric Co., Ltd. The subject covered being "Electrically Operated Thickness Gauges." Mr. Bourne was assisted by President Byers who very capably demonstrated the use to which the gauges may be put by measuring the thickness of plated metals such as cadmium, copper, zinc, also paint and enamel on steel. Since the method of testing is non-destructive, no damage is done to the samples being tested. Another outstanding feature of the gauge is that parts of the sample that may be inaccessible to many other testing mediums, may be quite easily tested for thickness.

The following officers were elected to conduct the business of the Branch for the next A.E.S. year. James Vaughan, President; Frank Oakley, First Vice-President; John McRoberts, Second Vice-President; Don Walker, Librarian; William Price, Sergeant-at-Arms; Ben Cameron, George Harris, Charles Kemish, Trustees; Ed Blandy, Secretary; Mel Green, Treasurer; John Acheson, Review Correspondent. The above named Officers constitute the Executive Board of the Branch.

We have learned through certain sources, that cannot be quoted at this time, that Art Mist and Ed Blandy, the Committee charged with the duties of preparing a speaker's program for one year commencing with our September meeting, have the list almost complete. We are advised that the list includes some of the most outstanding men in the plating industry. It is possible that we may have to obtain a larger meeting room beginning September.

JOHN ACHESON, *Review Correspondent*

SYRACUSE BRANCH

The Syracuse Branch held its regular monthly meeting on Friday, April 13, in Bowne Hall, Syracuse University.

President Murphy called the meeting to order promptly at 8:00 P.M. and then called upon the secretary for a reading of the minutes.

Following the reading of the correspondence, the business of electing a delegate to the annual business meeting of the Supreme Society was taken up. Neil C. Maffei was chosen to represent the Syracuse Branch at the meeting.

The question of the matter of raising dues to allow $1 annually for the Research Fund was tabled with no action taken.

A report by Mr. D. M. Overcash, chairman of the nominating committee was then given. A list of candidates for the respective offices was submitted. No nominations being made from the floor, a motion was made, seconded and carried that the nominees selected by the committee be confirmed as listed.

Dr. Walter R. Meyer was the speaker of the evening. Dr. Meyer discussed "Electroplating Upon Aluminum." The procedure involved was outlined in detail, including solution compositions specialized procedures for the several Aluminum Alloys. Some of the applications for electroplated Aluminum were discussed. It was pointed out that Aluminum would be used widely where weight is a factor and where outdoor exposure is not encountered.

The talk was well received and was followed by a rather long and interesting discussion period, after which the meeting was adjourned.

NEIL MAFFEI, *Sec'y-Treas.*

HARTFORD BRANCH

The April open meeting of the Hartford Branch was held April 16th at the Hotel Garde in Hartford. The first speaker, S. Zavarella, spoke on "Precleaning for Electroplating, Stressing the Importance of Solvent Emulsion Type Cleaners." The second speaker, Vincent Curll, talked on "Cements in the Plating Room." Both men are from the Pennsylvania Salt Mfg. Co.

George Hogaboom was present with his regular monthly feature, "Latest Developments."

The nominating committee presented the list of officers for the 1945-46 season to the members present. The entire slate was unanimously accepted and will assume their duties at the May meeting.

FRANK SMITH, *Secretary*

MONTREAL BRANCH

The Montreal Branch, A.E.S. met at the Mount Royal Hotel on Monday, April 2, 1945 at 8:45 P.M. under the chairmanship of Mr. J. Reisenburg.

The minutes of the previous meeting were moved adopted as read.

Correspondence was read and noted.

Mr. J. H. Feeley was nominated and elected to represent the Montreal Branch at the meeting to be held at Pittsburgh on June 18, 1945.

Outstanding bills were ordered paid.

Nomination and election of officers for the year 1945-1946:

President, Mr. R. E. Gordon; First Vice-President, Mr. C. A. Brisebois; Second Vice-President, Mr. G. R. Davidson; Third Vice-President, Mr. F. Boston; Secretary-Treasurer, Miss E. Gravelle, 267 Demarchais Blvd., Verdun, Quebec; Librarian, Mr. L. Larrivierre. Board of Managers, to be elected next month.

Meeting adjourned at 11:00 P.M.

WILLIAM G. FINLAY, *Sec'y-Treas.*

NEWARK BRANCH

The regular meeting of the Newark Branch, A.E.S. was held on Friday evening, April 20, 1945 at the Hotel Robert Treat in Newark, N. J. The meeting was called to order at 8:30 P.M. with First Vice-President Louis Donroe presiding. All other officers were present.

The minutes of the March 16th meeting were read and approved.

A communication from Hartford Branch asking Newark Branch to act as their Proxy to the Pittsburgh Convention was read and held over for new business.

A communication from Millard Loucks notifying the Secretary that he did not receive his MONTHLY REVIEW was read and the Secretary was ordered to report this to the New York office.

A communication from Jacques Kreisler Manufacturing Corporation asking for a copy of the Newark Branch Year Book was read and the request was granted.

A communication from Technical Societies Council of New Jersey was read and placed on file.

A communication from Executive Secretary E. T. Candee was read and placed on file.

The Secretary reported that it was the decision of the Executive Board, who held a meeting on Saturday, April 14th, that Dr. A. Kenneth Graham be appointed Executive Secretary and Business Manager at our Delegates' Meeting, June 18th, at Pittsburgh. A hearty round of applause was given to the Eexcutive Board's decision.

Under New Business the request of Hartford Branch to have Newark Branch act as their proxy at the Delegates' Meeting in Pittsburgh on June 19th, was brought up and it was voted that Newark Branch accept this assignment and send Hartford Branch a leter thanking them for this honor.

Our Librarian, Ed Washburn, presented the guest speaker for the evening, Mr. W. A. Helbig of Darco Corporation. Mr. Helbig gave us a most interesting talk on "Activated Carbon in Electroplating Solutions." He was accompanied by two representatives of the Industrial Filter Company who demonstrated how Activated Carbon should be used when filtering plating solutions. The demonstration was very instructive. Mr. Helbig was given a rising vote of thanks by the 67 members who attended this meeting.

Meeting was adjourned at 11 P.M.

GEORGE WAGNER, *Secretary*

PHILADELPHIA BRANCH

Philadelphia Branch held a dinner meeting at the Broadwood Hotel with all officers present and a total attendance of 83, including members from Boston and Pittsburgh Branches.

President Zurbach gave a hearty welcome to the members and guests.

Chairman Orlik, of the Branch Research Committee, read off the contributions received and made a plea for more funds.

President Zurbach introduced the speaker of the evening, Myron B. Diggin, of the Hanson-Van Winkle-Munning Co. His lecture, "Bright Alloy Plating," illustrated, was mighty interesting and well received.

Mr. Diggin crammed into his allotted time an excellent talk on the co-deposit of Copper, Tin, and Zinc, displaying samples of different articles plated bright in both still and barrel solutions.

The speaker claimed the alloy plate was

tarnish resistant, non-magnetic, and easy to solder, and answered the well put questions.

Mr. Diggin received a rising vote of thanks.

Then came the refreshments and the Floor Show (WOW!)

Chairman Verrell of the Entertainment Committee, surely planned a swell evening.

PAUL MENTZER, *Secretary*

BRIDGEPORT BRANCH

The April open meeting of the Bridgeport Branch was held Friday, April 20th at the Barnum Hotel in Bridgeport. President McNeil opened the meeting with a brief summary of the results of the election which was held at the last regular meeting. He then introduced the new President, Mr. Herman Braun of the Pitney Bowes Postage Meter Co. in Stamford. Mr. Braun was given a rousing reception.

In the absence of Librarian Fred Gotthardt, who was unavoidably absent for the evening, President McNeil introduced the speaker of the evening as Mr. Wililam Jackson of the Udylite Corp., Detroit, Mich. His topic was "Barrel Plating Technique and Equipment." Mr. Jackson gave a most informative lecture and in conjunction with his talk, distributed literature explaining proper barrel plating methods and showing some ideal lay-outs of barrel equipment. He gave some very interesting figures showing the relationship between current density, barrel loads and rate of deposition. He stressed the necessity for the minimizing of the labor involved in handling barrel equipment, and in his sketches, showed the various hopper type rinses, loading stands, motor driven cleaners, etc. that go to make up a barrel plating unit as nearly automatic as is possible to make them.

Mr. Jackson was well applauded and given a rising vote of thanks for his most excellent and unique paper.

President McNeil then thanked all members for their cooperation during his two years as President and pledged his support and cooperation to the new President.

The meeting, which was attended by 56 members and friends, was adjourned at 10:45 P.M.

JOSEPH G. STERLING, *Sec'y-Treas.*

CHICAGO BRANCH

The Chicago Branch held its monthly meeting on Friday, April 13, 1945.

President R. J. Hazucha announced the death of Frank Hanlon and Jack Geissmann. The Branch stood in silence for one minute in their respect.

The new officers for the ensuing year are: President, Paul Krause; First Vice-President, Clyde Kelly; Second Vice- President, Ernest Lyons; Librarian C. Willard Carter; Secretary and Treasurer, Marion Longfield; Board of Managers, J. W. Hanlon, Chairman; and R. J. Hazucha and Jack Bryden; Delegate, Frank Savage.

Mr. R. E. Pettit of Aluminum Company of America talked on the "Trend in Aluminum Finishing Applications." A display of many samples and different finishes were exhibited.

A very lively meeting adjourned at 11:15 P. M.

M. H. LONGFIELD, *Secretary*

COLUMBUS BRANCH

The new Columbus Branch of the American Electroplaters' Society held its first regular meeting on April 27, 1945, 8 P.M. at the Battelle Memorial Institute. President Leon Haas opened the meeting with about fifty members and guests present. The new branch was presented with a temporary charter by Mr. Walter L. Pinner First Vice-President of the Supreme Society.

A short discussion was held concerning the purposes and benefits gained from such an organization and the methods of proper operation of a branch of the A.E.S.

The members of other branches were introduced after which Mr. William Neill discussed the possibility of presenting a technical paper at the national convention by April, 1946.

Tom F. Lavery our librarian then introduced Dr. Charles L. Faust who gave an interesting background of our speaker of the evening, Mr. Walter L. Pinner. Mr. Pinner gave a very interesting talk on "High Speed Nickel Plating," which outlined the effects of current density, chloride concentration on the plate, effect of chloride on anode corrosion and ductility of the plate and the effect of brighteners

on the plate. Slides were shown to illustrate the points emphasized in the lecture. An interesting point in the discussion was that nascent chlorine may cause pitting in nickel if the bath contains wetting agents. A question and answer session followed the lecture.

The next meeting will be held on Friday, May 25, 8 P.M. at Battelle Memorial Institute with an exhibition and discussion of thickness measuring devices for plates.

The meeting was adjourned at 10:30 P.M.

The new officers of the Columbus Branch are as follows:

President, Leon Haas, D. L. Auld & Co.; Vice-President, H. A. Skinner, Ranco, Inc.; Secretary, D. S. Stoker, Battelle Memorial Institute; Treasurer, E. L. Combs, Battelle Memorial Institute; Librarian, Tom F. Lavery, Battelle Memorial Institute.

DAVID S. STOKER, *Secretary*

BRIDGEPORT BRANCH

The regular monthly meeting of the Bridgeport Branch of the American Electroplaters' Society was held Friday, April 6, 1945 at the Hotel Barnum. President A. R. McNeil opened the meeting at 8:30 P.M. with 26 members and guests present.

The roll call of officers was read and the Board of Managers, R. J. O'Connor and B. F. Kusterer and Sargeant-at-Arms L. F. Griffin were reported absent. The minutes of the previous meeting was read and accepted.

Reports of Special Committees:

William Ehrencrona, chairman of the Banquet Committee, reported on the progress being made at this time. There was a lot of discussion on this subject from our members and a final decision was made to let the committee proceed and report at our next regular meeting.

Reports of Standing Committees:

Hubert M. Goldman, chairman of the Membership Committee, reported two applications for membership.

The Publicity Committee reports progress is being maintained.

The Projector Committee reports that the sound projector is available to any member of our Branch.

The Sick Committee reported that Mr. Frank Hanlon, a beloved member of our Society and the Chicago Branch, as passed away. The Bridgeport Branch members expressed their deepest sympathy to Mrs. Hanlon and the Chicago Branch of the A.E.S.

F. B. Gotthardt, Librarian and Chairman of the Technical Sessions Committee announced a question box session with three experts in charge at the May 4th meeting. Fred also announced that Mr. William Jackson of the Udylite Corporation, Detroit, Mich., will speak on "Barrel Plating Practice and Equipment" on Friday, April 20, 1945 at 8:00 P.M. at the Hotel Barnum.

Election of Officers:

President, Herman C. Braun; First Vice-President, Hubert M. Goldman; Second Vice-President, Fred B. Gotthardt; Secretary and Treasurer, Joseph G. Sterling; Librarian, Clarence C. Helmle; Sergeant-at-Arms, John Schneider; Board of Managers, William A. Ehrencrona, William Thompson, and William Flaherty.

Delegate elected to the National Convention to be held in Pittsburgh, Pa. in June, 1945 in accordance with the current O.D.T. ruling and regulations.

Raymond J. O'Connor, Present Third Vice-President from the Bridgeport Branch, A.E.S.

Communications:

A letter from Supreme Vice-President Frank J. Savage commending us for our fine cooperation in obtaining new members to the Society was ordered to be placed on file.

A letter from Executive Secretary E. T. Candee advising us that an Executive Business Meeting will be held in Pittsburgh, Monday, June 18, 1945, and that each Branch will send one delegate to this meeting who will have the three votes assigned to each Branch. This point is important in order to maintain the attendance at the Convention of less than fifty members. A motion was made and carried to delegate R. J. O'Connor to this meeting, and also due to the fact that he now holds the office of Supreme Third Vice-President of the Society.

A letter from Supreme First Vice-President W. L. Pinner in obtaining papers to the June, 1945 meeting at Pittsburgh. C. C. Helmle gave us a talk on this and has offered to help any one interested in giving a paper.

A letter from Richard A. Dimon, chairman of the Educational Committee, Pittsburgh Branch, asking for the papers to be submitted for the 1945 Conference not later than June 1st, 1945 was ordered to be placed on file.

A letter from Executive Secretary E. T. Candee pertaining to the Research Committee Reports was ordered to be placed with the Research Committee Report's folder on file.

Unfinished Business: None.

New Business: No comments at this time.

Bills against the Branch were ordered to be paid.

Meeting was adjourned at 11:00 P.M.

JOSEPH G. STERLING, *Sec'y-Treas.*

NEWARK BRANCH

The regular meeting of the Newark Branch, A.E.S., was held on Friday evening, May 4, 1945, at the Hotel Robert Treat in Newark, N. J. The meeting was called to order at 8:45 P.M. with President Robert R. Sizelove presiding. All officers were present.

Communications from Grimes Manufacturing Company and General Motors Corporation, requesting a copy of the Newark Branch Year Book were read and the Secretary stated that their requests had been complied with.

Communication from Mrs. F. Hanlon thanking Newark Branch for their letter of sympathy was read and placed on file.

Communication from Walter Pinner was read and placed on file.

Mr. Ed Washburn and Mr. Howard L. Cobb reported that the paper to be presented by Newark Branch which was written under the direction of Mr. Cobb would be forwarded to the Convention Committee within five days.

Election of officers for the Year 1945-1946 followed. The newly elected officers are: President, Louis Donroe; First Vice-President, John DeVries; Second Vice-President, Edward Washburn; Secretary-Treasurer, George Wagner; Librarian, Howard L. Cobb; Sargeant-at-Arms, John Lavery; Board of Managers, Horace H. Smith, William Bruhns and Robert R. Sizelove.

Delegate to Convention, George Wagner. Mr. Tom Haddow conducted the installation in his usual appropriate manner.

Mr. Howard L. Cobb, our newly elected Librarian, presented as guest speaker for the evening, Michael Puglies. Mike is one of our own members. He gave us a very good paper on "Gold Plating for Radar Equipment." He exhibited numerous samples which had been gold plated .0002" thick and had a very smooth semi-lustrous deposit. Mike was given a rising vote of thanks by the 51 members who attended this meeting.

Meeting adjourned at 11 P.M.

GEORGE WAGNER, *Secretary*

BOSTON BRANCH

Boston Branch met Thursday, May 3rd at the Statler Hotel, Boston, with President Swift in the chair.

Minutes of the previous meeting read and approved; communications, read one from Baltimore-Washington Branch, this was put over to the June meeting, others were placed on file. Bills read, ordered paid.

Robert Magnuson was named to represent the branch at Pittsburgh, June 18th.

The chair named the following members: C. Gilbert, W. Harvey, and A. Mintie to act as a nominating committee to bring in a slate of officers at the June meeting.

The following were appointed by the chair to investigate the posibilities of improving the educational and social activities of the branch: L. Chesworth, H. Saltzburg, and Robert Magnuson.

With all business out of the way, the Librarian, Lennie Chesworth introduced the speaker of the evening, Mike Shacat of the United Chromium, Inc. The subject of his talk was "Porous Chromium." This talk was illustrated with excellent slides. He also had some samples that he passed around for the members to look at. He answered all questions for the members and was given a rising vote of thanks for a very interesting talk.

The meeting adjourned at 10:45 P.M.

A. W. GARRETT, *Sec'y-Treas.*

GRAND RAPIDS BRANCH

The April 13th meeting was properly opened by our President, Mr. C. M. Fernekes, who was presiding, who called on the nominating committee to present the names of the officers to be voted upon for

the coming year. These were presented and voted upon by all members present and the following members were elected to office:

President: Stewart Martin, Plating Dept., Chrysler Corp., 6700 Lynch Rd., Detroit 31, Mich.

First Vice-President: James A. Badaluco, 1053 Veto, N.W., Grand Rapids 4, Mich.

Second Vice-President: Philip A. Joyce, 907 Lake Michigan Dr., Grand Rapids 4, Mich.

Secretary: R. Perkins, 916 Fairmount St., S.E., Grand Rapids 6, Mich.

Treasurer: Traverse Williams, 1163 Second St., N.W., Grand Rapids 4, Mich.

Librarian: Kenneth Hampel, 138 Elwood St., Grandville, Mich.

Board of Managers:
M. R. Caldwell, 2332 Everest Ave., S.E., Grand Rapids 7, Mich.

I. C. Hepfer, 120 South Ottawa, Grandville, Mich.

Homer Morton, 2615 Albert Dr., S.E., Grand Rapids 6, Mich.

At this meeting, Mr. M. R. Caldwell was appointed to represent this Branch at the annual convention meeting to be held in Pittsburgh.

All other business and reports of committees were disposed of and the meeting was then turned over to our speaker, Mr. Harold Ransburg of the Electric Coating Division of the Harper J. Ransburg Company of Indianapolis, Ind. His subject was "Electrostatic Painting." This was a very interesting subject and was enjoyed by all members. Mr. Ransburg's talk included a discussion of the equipment required, how the process works, its effect on industry and scope of application. He also showed slides of several large insulations and other slides and data covering the equipment and method of use employed in the process of electrostatic painting.

The meeting was then adjourned and refreshments were served by the hotel.

C. E. ABEL, *Secretary-Treasurer*

INDIANAPOLIS BRANCH

The Indianapolis Branch of the American Electroplaters' Society held its monthly meeting, May 2, 1945 at the Hotel Riley. A dinner was served at 6:45 P.M. and the business meeting was called to order at 8:00 P.M. by our President, Mr. A. L. Chesterfield.

The secretary's report and the treasurer's report for the fiscal year, May 1, 1944 through April 30, 1945 were read and approved as read. Mr. Morris pointed out that during the past year 46 members had been added to the Indianapolis Branch.

Mr. Chesterfield reported that a committee composed of W. R. Binai, W. W. Cothran, and H. L. Stebbins were perfecting plans for a dinner-dance to be held, tentatively, May 19. Mr. Chesterfield stated that each member would be advised of the final arrangements within the next few days.

Branch officers for 1945-1946 were then elected. They are: Carl R. Morris, President; Arthur L. Chesterfield, Vice-President; Quentin O. Shockley, Secretary and Treasurer; Carl F. Niehaus, Librarian; Albert P. Kriese, Arthur R. Ferguson and Arthur L. Schmidt, Board of Managers. Mr. Chesterfield then turned the meeting over to Mr. Morris who presented the other new officers.

Mr. Alvin Caldwell announced that after 27 years in plating and allied fields he has retired to actively manage his golf club at Marion, Ind. Mr. Caldwell invited the members of the Branch to collectively or individually visit his club and asked to be considered an inactive member of the Branch. Mr. Morris, speaking for the Branch, thanked Al for the invitation and expressed regrets at hearing that Al is leaving the plating business. The Indianapolis Branch to which Al has been a great asset, wished him the greatest of success in his new business and sincerely invites him to attend any and all functions of the Branch.

Mr. Thomas Evans invited the Branch to attend the official opening of his new plant at the Plating Service Company, Columbus, Ind. Many members expressed their intentions to attend.

The meeting adjourned at 8:45 P.M.

The next regular meeting of the Indianapolis Branch will be September 5, 1945.

QUENTIN SHOCKLEY, *Sec'y-Treas.*

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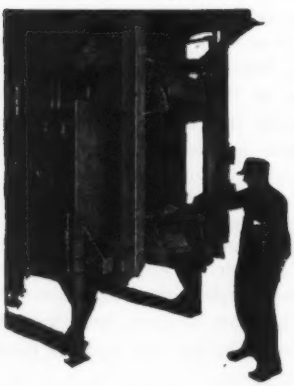

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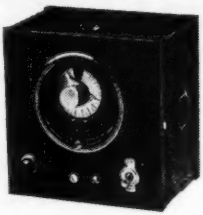

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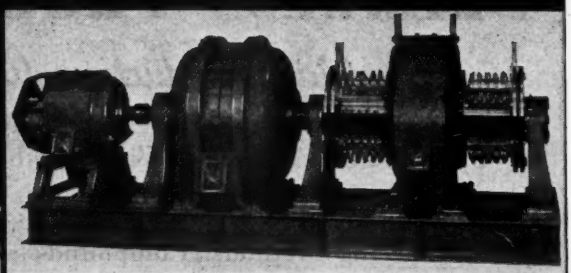

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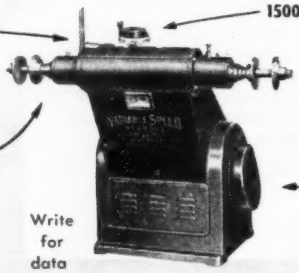

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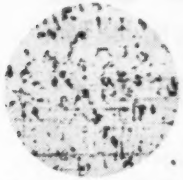

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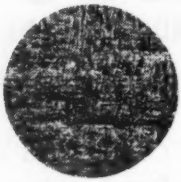

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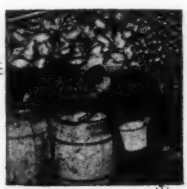

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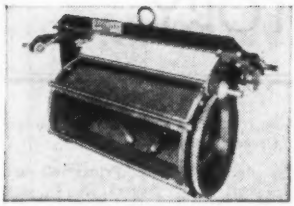
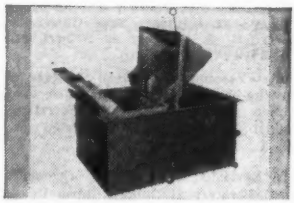
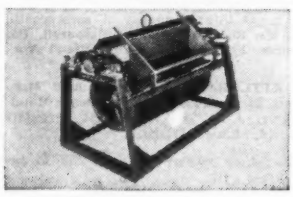


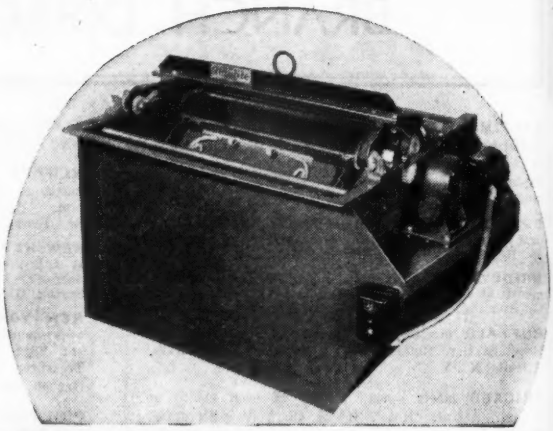
Plating cylinder.



Doube chute perforated rinse.



Loading stand with hopper.



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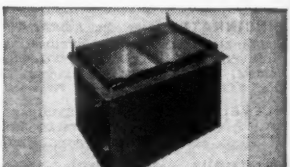
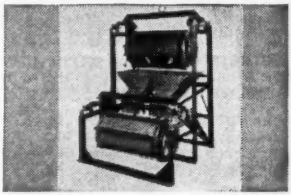
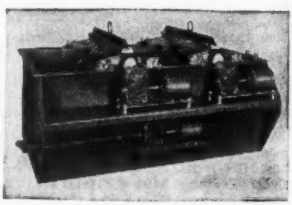


Hopper type, rinse unit.



Transfer stand.



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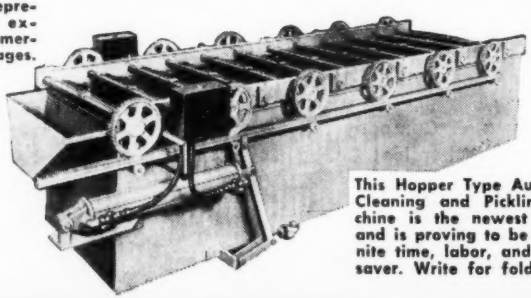

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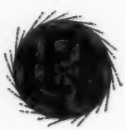

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